A TREATISE UPON GRAVEL AND UPON GOUT,

IN WHICH
THEIR SOURCES AND CONNECTION
ARE ASCERTAINED;
WITH AN EXAMINATION OF
DR. AUSTIN'S THEORY OF STONE,
AND OTHER CRITICAL REMARKS.

A DISSERTATION ON
THE BILE, AND ITS CONCRETIONS,
AND AN ENQUIRY INTO THE
OPERATION OF SOLVENTS.

BY MURRAY FORBES,
MEMBER OF THE SURGEONS' COMPANY.

CUJUS AUTEM REI NON EST CERTA NOTITIA, EJUS OPINIO CERTUM REPERIRE REMEDIUM NON POTEST—EUM VERO RECTE CURATURUM, QUEM PRIMA ORIGO CAUSÆ NON FEFELLERIT. CELS.

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PREFACE.

IT is now almoſt ſeven years ſince the principal part of the matter contained in the following ſheets was made public, under the title of *A Treatiſe upon Gravel and upon Gout, in which the ſources of each are inveſtigated, and effectual means of preventing, or of removing thoſe diſeaſes, recommended.* The author, at that time, with-held his name from the world, not from any difficulty he apprehended in maintaining the ſyſtem which he had preſumed to advance, but from an idea that it might meet with more impartial regard, if it came into conſideration without reſpect to himſelf. From an eſtabliſhed fame, a favourable reception may frequently be derived to even a trivial work; but from a name that had not met the public ear, there was not any intereſt that could be expected, while fatal indifference and neglect might be apprehended. On this account he courted concealment, and he truſts his motive will furniſh an excuſe that may be received with indulgence.

He has not any reaſon to complain of the manner in which his production was treated: he thinks it attracted as much attention as could be ſuppoſed to fall to the ſhare of an anonymous medical publication. Frequently, however, he has had the concern to hear himſelf condemned for requeſting confidence to opinions, which he had not poſſeſſed reſolution to avow. The veil behind which he wrote, has been reflected upon as a ſign of diſtruſt of his own theory, if not of intentional deception. He muſt aſſent to the juſt grounds of ſuſpicion, and anxious to eſcape from them, has determined to commit his ſentiments to the unpropitious prejudice they may encounter from the obſcure and private condition of the perſon by whom they are profeſſed. He felt it likewiſe a duty to aſſert his right to principles, which others, taking advantage of his remaining in the dark, ſeemed inclined to appropriate to themſelves. Ideas which had been ſo long unclaimed were perhaps regarded as fair ſpoil; or charity might prompt to the adoption of offspring which appeared deſerted and deſtitute, or left in an orphan ſtate. To have taken them under protection, with juſt acknowledgment of the manner in which they were picked up, would have been benevolent and humane; but when a new patron labours to produce oblivion of original deſcent, the priviledges of adoption are exceeded.

At *Edinburgh* there have been two predatory efforts, with which the author was not acquainted until the main body of his treatiſe was in the preſs. If he had happened to have more early information, he might have beſtowed a few pages in comment, under thoſe ſections where, with beſt propriety, critical obſervations might have been introduced. As on a different account there was occaſion for a poſtſcript, he has taken that opportunity of briefly expreſſing his ſenſe of the kindneſs that has been diſplayed in favour of opinions to which, in their general tenor, he ought to be partial, although he may revolt againſt particular deviations and miſapplications to which they have been expoſed.

The preſent publication comprehends one ſubject which was not included in the laſt.—The diſſertation upon bile, and its relation to the other affections which are diſcuſſed, is additional matter ſo intimately connected with the former ſubjects, as to render neceſſary a new arrangement for the purpoſe of introducing it. It may likewiſe be ſuppoſed, that in the courſe of the time which has elapſed, there have been, upon different principles, productions on the ſame conditions of diſeaſe.—The moſt important was Dr. Auſtin's Gulſtonian Lecture, upon which the author has commented with freedom: he had compoſed his remarks before the Doctor's untimely death, and was in hopes, if that mournful event had not taken place, to the general ſorrow and loſs, that the obſervations he felt himſelf compelled to make upon a popular work, might have again brought the ſubject under the conſideration of a man whoſe abilities were equal to a ſubſtantial ſupport of his opinion if it was well founded, and whoſe candour would not have heſitated at confeſſion of error on conviction of miſtake.

The author is not endeavouring to paſs a plauſible fiction on the public. He aims not at the undecorous fame of promulgating a ſplendid hypotheſis, which ſhall ſeem well connected in all its parts, while the baſis is viſionary. His endeavours have been directed to the inveſtigation of truth, which he has ſtudied to ſuſtain by chemical deduction. Reaſoning upon eſtabliſhed chemical facts comes as near to perfection as any argument that does not reſt upon mathematical evidence. The concluſions to which his enquiry leads, are of the firſt importance, and demand conſideration. It is of conſequence that they ſhould be confuted or confirmed. His deſire is to afford illuſtration of diſeaſes which were before unexplained, and he does not ſhrink from a minute diſcuſſion of his endeavour. He is earneſt to ſolicit the ſtricteſt ſcrutiny of candid criticiſm, that he may recede from his errors if they can be made evident, or be furniſhed with opportuities of replying to objections that may proceed from the miſtakes or miſconceptions of his readers. He does not deprecate, but courts a cloſe examination of the argument, and will acknowledge himſelf obliged by every comment.

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A
TREATISE
UPON
GRAVEL, &c.

INTRODUCTION.

THERE are few diſeaſes from which greater ſufferings are endured, than from urinary concretions; yet, notwithſtanding their frequency, very little has been known concerning the circumſtances which produce them, or the means by which they may be prevented. In proof of this aſſertion, witneſs the very painful and dangerous operations that are daily put in practice for the extraction of ſtones. Calculi in the bladder, regarded with reſpect to the agonies they occaſion, and the means by which they have commonly been removed, may be enumerated among the moſt heavy of human infirmities. The nature of man is not expoſed to many inflictions of greater ſeverity.

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The affection which paſſes by the name of gout, has engaged much attention in every age. It is, on account of the violence of its ſymptoms, and the numbers that labour under it, a malady of the moſt ſerious importance. Phyſicians have exerted themſelves to find out a remedy for it, but their endeavours have not hitherto been crowned with ſucceſs. Among modern diſcoveries, the improvements in medicine are not the leaſt conſiderable; yet it is remarkable, that no material advantage has been gained in the inveſtigation of this diſeaſe. Experience has taught in what manner its violence may be mitigated, but no effectual means of guarding againſt it have as yet been ſuggeſted. The moſt eminent of the profeſſion have acknowledged themſelves unacquainted with the cauſe of gout, and for this reaſon it has emphatically been termed the OPPROBRIUM MEDICORUM.

An examination of the various theories that have been formed reſpecting theſe diſeaſes, would be tedious and unentertaining. Many of them were plauſible, while others have not had even ingenuity to recommend them. They are complaints with which the rich and the luxurious are very frequently afflicted; and the eagerneſs of ſuch to be relieved, has expoſed them to become the dupes of deſigning and unprincipled individuals,

viduals, who, by arrogance and impoſition, levy immenſe contributions upon impatience and ſimplicity. While it is admitted that every other ſcience is to be learnt by ſtudy and application alone, an opinion appears to prevail that the medical art may be obtained upon eaſier terms, and the higheſt confidence is placed in the vapouring profeſſions of ignorant and illiterate quacks. Fortunate it would be, if the noſtrums of ſuch pretenders were merely unavailing towards the end for which they are adminiſtered: but inertneſs is not the general quality of boaſted ſpecifics. Articles of precarious activity are crowded together without judgment, and exhibited without diſcrimination. Too often the conſtitution is ſacrificed to the blunders of empirics, and the unhappy employer laments his credulity when the melancholy conſequences are irretrievable. It is amazing that men of underſtanding ſhould ever commit the management of their deareſt concerns to the blind guidance of ſuch pretenders. Yet it muſt be confeſſed, that the avowed ignorance of regular practitioners, in reſpect to the production of gravel and gout, has afforded the beſt apology for quackery.

The origin of theſe diſeaſes it is our aim, and we truſt within our power, to illuſtrate. Without ſtepping aſide to comment upon the numerous opinions that have been entertained, opportunities will occur of making obſervations upon particular ſentiments. The principal object of the preſent deſign is, to eſtabliſh, by evidence that ſhall reſt upon experiment, the means by which gravel and gout are produced. The concluſions will be found conſiſtent with the beſt practical remarks of the moſt reſpected authors. A connexion has generally been ſuſpected between them. They were both conſidered as hereditary, and the female offspring of gouty parents have often been regarded as peculiarly liable to nephritic affection. They were remarked frequently to occur under correſponding circumſtances, and in the ſame patient. The appearance in gout, of a matter ſimilar to that of which urinary concretions are formed, afforded, in many caſes, a ſtrong preſumption of relationſhip. The diſeaſes, in a word, were ſuppoſed to be frequently occaſioned by the ſame means, and relieved by the ſame remedies. We ſhall ſoon be ſatisfied, that the conjecture, which had been adopted from obſervation, without much reſpect to the cauſe of either, was well founded, and that the alliance is intimate. They are affections of which the ſources are the ſame, and the conſequent alterations not very diſſimilar. The differences will be perceived to depend upon peculiarities, in ſtructure and functions, of the parts concerned. In proſecuting the enquiry, the bile, and a particular change to which it is liable, will come under conſideration. But before we enter upon the cauſe, and its effects, or the circumſtances that appertain to it, we muſt proceed to a view of the matter of gravel.

SECTION I.

On the Matter of Urinary Concretions.

THE concretions generated in the urinary paſſages are of various ſizes and figures. They differ, likewiſe, from each other, in reſpect to colour, texture, and ſpecific gravity. A conſiderable degree of variety is frequently obſervable in the ſame concretion, for when cut into they are found of a laminated ſtructure, and the ſeveral lamina are ſometimes very different in appearance. An infinite number of opinions have been held reſpecting the matter of them; but it does not appear that many experiments were made, by which any accurate knowledge of its properties could be obtained. The qualities aſcribed to it had their foundation in conjecture merely. It was conſidered as acid by ſome, and as alkaline by others. Not unfrequently it was compared to the tartar, which is ſeparated from wines during fermentation; and in treating of it, many authors were uſed to talk of earth, ſalts, air, oil, and ſulphur, without appearing to have any preciſe ideas in regard to the meaning of theſe terms.

Urinary concretions, from having a conſiderable reſemblance to chalk-ſtones, were frequently conſidered as calcareous earth. This opinion was more prevalent than any other in reſpect to their compoſition. It originated from outward appearance, but was ſuppoſed to have received confirmation from experiment. It was maintained in the medical theatres, and ſeldom called into queſtion.

At length an inveſtigation of the properties of this matter was entered upon by Mr. Scheele and Sir T. Bergmann, thoſe diſtinguiſhed chymiſts, to whom the world is indebted for many important and valuable diſcoveries, with which ſcience has been enriched. From the reſult of their operations, which were proſecuted without any prepoſſeſſion from the vague enquiries of others, it appears, that urinary concretions, however different in colour and texture, are eſſentially the ſame, and that they are formed of a peculiar ſubſtance, which, on account of ſome of its properties, they conſider as an acid. If they contain any calcareous earth, it is generally in ſo ſmall a proportion that it was entirely overlooked by Mr. Scheele. Bergmann imagined that he diſcovered a very minute quantity of it; but the experiment upon which his ſuſpicion was grounded, is far from being ſatisfactory. At any rate, the proportion amounting to not a hundredth part of the whole maſs, is too inconſiderable to require being noticed.

Mr. Scheele has informed us that the powdered calculus was diſſolved by concentrated vitriolic acid, with the aſſiſtance of heat, but that the muriatic acid had not the ſmalleſt effect upon it, even when boiled with it. Theſe ſimple experiments were ſufficient to prove that it is not chiefly formed of calcareous earth. It is a property of that earth to combine with vitriolic acid into an almoſt inſoluble concrete, while it unites very readily with muriatic acid, into a compound ſo eaſy of ſolution as to attract water from the atmoſphere.

The calculus was attacked by concentrated nitrous acid with great violence, and with the aſſiſtance of heat it was readily diſſolved by the ſame acid diluted. The acid of ſugar, which attracts calcareous earth from every other acid, and unites with it into a ſubſtance inſoluble in water, did not produce any precipitation when mixed with this ſolution: neither was there any material effect from the addition of alkali. The compound of the matter of calculi with the diluted nitrous acid, was of a yellow colour.

When the ſaturation was complete, it betrayed very little of the ſmell or taſte of the acid, and it had a ſingular property of communicating red ſpots to the ſkin. On evaporating it to dryneſs, there remained a roſe-coloured ſpungy maſs, eaſily ſoluble in water, to a large quantity of which it gave a deep red colour.

The powdered calculus was not in any manner affected by a ſolution of mild alkalis, either fixed or volatile, but it was entirely diſſolved by ſuch as were perfectly cauſtic. Theſe ſolutions likewiſe were of a yellow colour, and the calculus was precipitated by every acid, and by fixed air.

The matter of urinary concretions was diſſolved by digeſtion in lime-water. Four ounces of the latter were required for twelve grains of the former; and the ſolution, like the alkaline ones, was decompoſed by acids.

The calculus was ſoluble in boiling water, in the proportion of about eight grains to five ounces, and the greateſt part of it was depoſited in fine cryſtals, as the fluid became cold. The ſolution gave a red colour to paper ſtained with lacmus.

It appeared adviſable to relate thus much of the experiments of Mr. Scheele, as ſome of my readers may not have had an opportunity of peruſing his ingenious eſſay. From the whole he concludes, that the matter of urinary concre-

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tions is not calcareous, but a peculiar acid ſalt, with which is blended a portion of animal gelatinous matter. Its ſolubility in boiling water, and the cryſtaline form which it afterwards aſſumed, induced him to conſider it as a ſaline ſubſtance. The alteration of colour, produced by the ſolution on lacmus, was the mark of its acidity. The obſervations of Bergmann were nearly to the ſame purpoſe.

Notwithſtanding the deference that was due to the opinions of theſe gentlemen, many doubts have been entertained reſpecting the propriety of claſſing this matter among acids. It does not betray any acidity to the taſte. The colour of ſyrup of violets is not affected by the ſolution of it in boiling water. In its combination with alkalis and lime, there is ſomething that makes againſt the opinion of its being an acid; for, unlike to other acids, it is precipitated from them by fixed air. In this reſpect, the compounds are analogous to ſoaps formed by the union of alkalis with oily and mucilaginous ſubſtances.

On the other hand, the circumſtance of its communicating a red colour to paper ſtained with lacmus, was a ſtrong preſumptive proof of its acidity. The lacmus is a nicer teſt than the juice of violets, and diſcovers more readily the ſmalleſt quantity of acid. The inſipidity of this matter might be owing to water not being capable of taking up a quantity ſufficient for producing any effect upon the tongue, as nothing can be taſted unleſs applied in a ſtate of fluidity or ſolution. The decompoſition of its compounds with alkalis and with lime by fixed air, was a point from which no poſitive deduction could be drawn. That air has been proved to be itſelf an acid. It has been termed the *aerial* acid, from the circumſtance of its being a vapour in the heat of the atmoſphere. At preſent it is more generally diſtinguiſhed by the name of *carbonic* acid, from including charcoal in its compoſition. It was not, therefore, improbable, that the matter of calculi might be an acid, of which the attraction to alkalis and to earths is leſs powerful than that of carbonic acid to the ſame ſubſtances.

It ſeemed obvious, from the effects of alkalis and lime, that the calculus, if not properly an acid, muſt be of a muciiaginous or gelatinous nature. With a view of clearing up the uncertainty in regard to it, I examined with attention its compound with cauſtic fixed vegetable alkali, and my concluſions were in favour of its being an acid. Theſe ſubſtances, when united, did not, in taſte or in appearance, carry the leaſt reſemblance to the ſaponaceous compounds produced by the union of alkalis with the gelatinous parts of animals.

It occurred to me that the matter of calculi, if an acid, might admit, like other acids, of being combined with magneſia; and that the union, if it could be effected, would furniſh deciſive teſtimony of its nature. A few grains of a concretion of a reddiſh colour, firm texture, and conſiderable ſpecific gravity, were rubbed in a glaſs mortar with an equal quantity of *calcined* magneſia, and three or four drachms of diſtilled water. Theſe articles were then put into a little vial, which was ſuſpended over a lamp till the fluid had boiled for a few minutes. The whole was then poured upon a filtering paper, and the liquor, which immediately paſſed through, was of a yellow colour, like the ſolution of calculus in cauſtic alkali. I was ſatisfied, from the appearance of it, that a combination had taken place. It became turbid as it cooled, and there was depoſited an aſh-coloured powder, which, upon examination, proved to be neither magneſia nor calculus in a ſimple ſtate, but a compound of the two. This powder was immediately re-diſſolved on making a ſecond application of heat, and the whole became tranſparent again. To one part of the ſolution in this ſtate, a drop or two of muriatic acid was added, and the matter of the calculus was precipitated. A ſmall quantity of cauſtic alkali was mixed with another part of it, and a depoſition of magneſia took place. In the firſt inſtance, the muriatic acid united with the magneſia ſo as to ſeparate the calculus; in the ſecond, the cauſtic alkali attached itſelf to the matter of the calculus, and cauſed the magneſia to be precipitated.

This laſt experiment afforded the moſt perfect ſatisfaction, in regard to the point which it was intended to elucidate; it eſtabliſhed, in the fulleſt manner, the acidity of the matter of urinary concretions. Cauſtic alkalis and lime are capable of being combined with the oily, the reſinous, and the gelatinous parts of animals; but magneſia, when freed from carbonic acid by perfect calcination, is capable of being united with acids alone into ſoluble compounds.

The compound of the calculus with magneſia is diſſolved by water in a much larger proportion than the calculus by itſelf. If a little muriatic acid be mixed with a ſaturated ſolution while hot, the matter of the calculus ſeparated in the form of a fine white powder, will be in ſufficient quantity to give to the whole the conſiſtence of cream. After ſtanding for ſome time, the particles of this powder, by getting together, become larger, and ſubſide to the bottom. If an acid be added to a very diluted ſolution of the compound, and the whole permitted to remain at reſt for a few hours, the precipitate appears in fine cryſtals adhering to the ſides of the vial.

I obtained a further confirmation of the acidity of the calculus by combining it with the pure earth of alum, of which the precipitation had been effected by cauſtic alkali. This matter had been ranked among acids without having been expoſed to theſe concluſive teſts. The novelty of Scheele's obſervations has drawn the attention of many ſubſequent inveſtigators to concretions in the bladder, without much having been added to the general ſtock of knowledge. Recent opinions concerning the ſubſtance of calculi, appear to have been formed almoſt entirely from its decompoſition by fire, in preference to a more natural and ſatisfactory means of inveſtigation, its effects upon other bodies. It has been expoſed, in retorts and crucibles, to every poſſible alteration from heat. Nice diſcrimination of the various products, and accurate meaſurement of the different vapours proceeding from it, have been made, while the original matter in its native ſtate has been almoſt neglected. It is evident, from the effect of fire, that this acid is a compounded body. Under the action of a certain degree of heat, it is decompoſed, and yields nearly the ſame products as animal matter, with the exception of a peculiar ſublimate, which becomes of conſequence from having been made a ground of diſtinction among calculi. There remains after the proceſs a coal, convertible by the force of fire into earth. I have remarked, that the compounds of this matter with alkalis and magneſia, began to emit, when evaporated to dryneſs, vapours of volatile alkali in a degree of heat not very conſiderable. It is certainly an article, towards the formation of which many elements are united; but the derangement by fire of theſe attractions, by which they are combined, does not much contribute to illuſtrate the nature of it. The matter of urinary concretions is probably an acid ariſing out of a particular modification of animal particles, with properties depending upon that modification. Reſolution by fire is entitled to attention, and a fit object of curioſity, but ought not to be made the principal ſtandard of deciſion in regard to particular forms of animal and vegetable matter, whoſe extraordinary properties proceed from peculiarity of modification. The acids of tartar, of ſugar, and other acids, are equally capable of being decompounded by fire. Heat gives occaſion to a new ſeries of combinations, by which the particular diſtinctions of different kinds of animal and vegetable matter are loſt. The products obtained are not always elements merely, but frequently new compounds, ſpringing from a different arrangement of elementary principles, and towards the compoſition of which, the common air, and the matter of fire, may have contributed. We cannot, therefore, put down as actually conſtituting calculus, the ſeveral articles that may be collected from it by ſublimation, and much leſs can we decide upon its native properties, from the reſult of analyſis by fire. As well might we take diſtillation as a criterion by which the nature and qualities of expreſſed oil ſhould be inveſtigated. Let endeavours be chiefly directed towards marking its properties with relation to other matter.

Many have been inclined to conſider the calculus as a particular condition of phoſphoric acid, but there has not been adduced any ſatiſfactory experiment that can warrant the ſuſpicion. Phoſphorus and its acid are indeed matters of a ſingular kind, which appear to enter univerſally into the compoſition of animal ſubſtances, and are known to admit of variety of modifications, of which it is not impoſſible that the acid of concretions might be one; but we are unacquainted with any ſolid grounds from which correſpondence can be inferred. Every trial to which it has been put, tends to evince the peculiarity and diſtinction of this matter as a ſeparate acid; and ſuch it ought to be regarded, till actual connexion has been aſcertained. We had named it, the *concreting acid*, or *acid of calculi*; but Greek derivations are in faſhion, and now it is commonly known by the term of *Lithic*, or *Lithiſiac acid.* It is a concrete ſalt with acid properties peculiar to itſelf, and in a ſtate that may generally be conſidered as a condition of tolerable purity. It is not, as ſome have ſuppoſed, a ſmall quantity of an acid wrapt up in a large portion of mucilaginous matter; but a concretion is a body with unity of properties depending upon a particular arrangement of elements, that pervades almoſt every particle of the maſs. The quantity of animal matter, that is only mechanically blended, without having aſſumed ſuch arrangement, may not always be the ſame, but is ſeldom conſiderable. It is complex with reſpect to compoſition; yet, as an acid, ſimple in its properties; and, in the circumſtance of its acidity, ought to be brought to trial as a body of homogeneous qualities.

of many ſubſequent inveſtigators to concretions in the bladder, without much having been added to the general ſtock of knowledge. Recent opinions concerning the ſubſtance of calculi, appear to have been formed almoſt entirely from its decompoſition by fire, in preference to a more natural and ſatisfactory means of inveſtigation, its effects upon other bodies. It has been expoſed, in retorts and crucibles, to every poſſible alteration from heat. Nice diſcrimination of the various products, and accurate meaſurement of the different vapours proceeding from it, have been made, while the original matter in its native ſtate has been almoſt neglected. It is evident, from the effect of fire, that this acid is a compounded body. Under the action of a certain

degree

elements are united; but the derangement by fire of theſe attractions, by which they are combined, does not much contribute to illuſtrate the nature of it. The matter of urinary concretions is probably an acid ariſing out of a particular modification of animal particles, with properties depending upon that modification. Reſolution by fire is entitled to attention, and a fit object of curioſity, but ought not to be made the principal ſtandard of deciſion in regard to particular forms of animal and vegetable matter, whoſe extraordinary properties proceed from peculiarity of modification. The acids of tartar, of ſugar, and other acids, are equally capable of being decompounded by fire. Heat gives occaſion to a new ſeries of combinations, by which the particular diſtinctions of different kinds of animal and vegetable matter are loſt. The products obtained are not always elements merely, but frequently new compounds, ſpringing from a different arrangement of elementary principles, and towards the compoſition of which, the common air, and the matter of fire, may have contributed. We cannot, therefore, put down as actually conſtituting calculus, the ſeveral articles that may be collected from it by ſublimation, and much leſs can we decide upon its native properties, from the reſult of analyſis by fire. As well might we take diſtillation as a criterion by which the nature and qualities of expreſſed oil ſhould be inveſtigated. Let endeavours be chiefly directed towards marking its properties with relation to other matter.

Many have been inclined to conſider the calculus as a particular condition of phoſphoric acid, but there has not been adduced any ſatiſfactory experiment that can warrant the ſuſpicion. Phoſphorus and its acid are indeed matters of a ſingular kind, which appear to enter univerſally into the compoſition of animal ſubſtances, and are known to admit of variety of modifications, of which it is not impoſſible that the acid of concretions might be one; but we are unacquainted with any ſolid grounds from which correſpondence can be inferred. Every trial to which it has been put, tends to evince the peculiarity and diſtinction of this matter as a ſeparate acid; and ſuch it ought to be regarded, till actual connexion has been aſcertained. We had named it, the *concreting acid*, or *acid of calculi*; but Greek derivations are in faſhion, and now it is commonly known by the term of *Lithic*, or *Lithiſiac acid*. It is a concrete ſalt with acid properties peculiar to itſelf, and in a ſtate that may generally be conſidered as a condition of tolerable purity. It is not, as ſome have ſuppoſed, a ſmall quantity of an acid wrapt up in a large portion of mucilaginous matter; but a concretion is a body with unity of properties depending upon a particular arrangement of elements, that pervades almoſt every particle of the maſs. The quantity of animal matter, that is only mechanically blended, without having aſſumed ſuch arrangement, may not always be the ſame, but is ſeldom conſiderable. It is complex with reſpect to compoſition; yet, as an acid, ſimple in its properties; and, in the circumſtance of its acidity, ought to be brought to trial as a body of homogeneous qualities.

SECTION II.

On the natural Condition of that Matter in the Urine, and its preternatural Concretion into Gravel and Calculi.

MR. SCHEELE was not ſatisfied with aſcertaining the nature of concreting matter, but carried his inquiry to its ſource, and found it in the urine. When a quantity of freſh urine had been made to boil until much diminiſhed by evaporation, there was depoſited, as it became cold, a white powder, which in part adhered to the ſides of the glaſs, and appeared ſimilar in properties to the ſubſtance of urinary concretions. He was of opinion that the common lateritious ſediment, which is perceived under particular ſtates of the body, conſiſts of the ſame matter.

Reflecting upon the experiments that have been related, I ſuſpected that the concreting matter, of which a very minute portion only could be retained in ſolution by urine of the animal heat, muſt be ſuſpended by combination with ſome other matter, from which it might be precipitated by a ſtronger acid. I made the experiment, and was highly gratified with the event. It led to the diſcovery of a fact, which is ſimple in itſelf, but becomes extremely important from the intereſting conſequences to which it conducts, and the relation it bears to material effects upon the body. It lays the foundation of new ſyſtems, throws light upon what was obſcure, and will be found adequate to a complete explanation of the concreting proceſs. If twenty drops of muriatic acid, or a ſmall quantity of any other acid, be agitated into half a pint of clear urine, a number of ſmall chryſtals of a reddiſh brown colour will be diſcovered, after a few hours, on the inſide of the vial, and at the bottom of it. Or, ſometimes, inſtead of diſtinct and tranſparent chryſtals, there will be a depoſition of a fine powder, by which the urine is rendered turbid, in the ſame manner as by the lateritious ſediment. Not uncommonly a part of the depoſite is in a chryſtalline form, and the remainder in that of a flaky ſediment. But the matter of both is the ſame.

I collected a conſiderable quantity of this matter, by filling, every morning, a quart bottle with recent urine, to which was added a drachm or two of muriatic acid. On the ſucceeding day, when the chryſtallization was complete, I cauſed the fluid to be poured off, with care that none of the chryſtals were loſt. The bottle was then filled as before, and the proceſs continued until the inner ſurface had acquired a thick cruſt of the adhering matter. By violent agitation with a few ounces of cold water, a great number of the chryſtals were detached from the glaſs, and fell to the bottom. The others were ſeparated by means of a feather, and the whole was poured upon a ſtrainer of fine linen, in which, after the water had paſſed through, there remained about two drachms of a matter in appearance like red ſand. This matter, when chemically examined, turned out to be of the nature of urinary concretions. Like the calculus, it was ſoluble with the aſſiſtance of heat in concentrated vitriolic acid. Like the calculus, it united with diluted nitrous acid into a yellow ſolution, which poſſeſſed the properties of communicating red ſpots to the ſkin, and of leaving on evaporation a roſe-coloured ſpongy maſs. Like the calculus, it was capable of being combined with cauſtic alkalis, both fixed and volatile, with lime, with magneſia, and with the pure earth of alum; from all which it was precipitated by every other acid. Like the calculus, it was diſſolved by pure boiling water, and in like manner it was depoſited in cooling. It would have been difficult for the moſt accurate chemiſt to diſtinguiſh between the matter of theſe chryſtals and that of a real concretion from the kidnies or bladder. The chryſtals are the ſpecific matter of calculi; the pure concreting acid which forms the baſis of urinary concretions. For inveſtigating the properties of that acid, they are to be preferred to the calculus itſelf, becauſe it is probable, that to a ſtone in the body, a little of any adventitious matter happening to be contained in the urine may frequently adhere.

Conſidering how much the urine has ingroſſed the attention of medical men, who at all periods have been turned towards it with experimental regard, there is much cauſe of aſtoniſhment, that the precipitation of lithic matter by acids ſhould have eſcaped obſervation. Perhaps the time that is generally requiſite for the formation of the chryſtals has occaſioned them to be overlooked. There is not commonly, at firſt, any evident mark of decompoſition, but the lithiſiac acid continues ſuſpended for an hour or two after it has been detached. Sometimes, however, the proportion of it is ſo conſiderable as to cauſe an immediate loſs of tranſparency, and the chryſtals in that caſe are not in general very perfect, a part of the ſediment remaining in a ſtate of fine powder. I have not met with any urine from which a ſmall quantity of it may not be obtained.

In the urine of health, the whole lithiſiac matter appears to be naturally combined with ſome other ſubſtance, by which it is retained in a fluid ſtate. There is always in this fluid alkalis, both fixed and volatile, in conjunction with acids. There is likewiſe lime united with phoſphoric acid; and the compound of the two forms an earthy ſubſtance, known by the names of phoſphorated lime and animal earth, with which lithiſiac acid may be combined in the ſame manner as with magneſia. I ſucceeded in combining it with a portion of that earth procured from the urine by precipitation with cauſtic volatile alkali. The compound was more eaſy of ſolution than the ſimple acid. With alkali then, or with lime, or with phoſphorated lime, the whole of which in the urine is ſuſpended by ſuperabundant acid, the concreting matter may be in native conjunction. A table of the general order of elective attractions is ſeldom ſufficient for explaining the condition of combination of ſeveral different bodies when in a compounded ſtate; and a train of nice and accurate experiments would be neceſſary for affording certain evidence of the particular matter with which lithiſiac acid is combined. From the weakneſs, however, of its attractions to alkalis and earths, it may be preſumed to be united to the weakeſt in affinity to acids, or the phoſphorated lime, while the others are poſſeſſed by the ſtronger acids. That, in this caſe, the weakeſt are in conjunction, is rendered probable by the following obſervation and experiment.

A portion of the phoſphorated lime in the urine appears to be kept in ſolution by the aerial or carbonic acid, whoſe attractions are the weakeſt, excepting thoſe of concreting acid. When tranſparent urine in a vial is ſuſpended over a fire, there ariſes, as the heat increaſes, a froth upon the ſurface; and, as it approaches to the boiling point, the whole is rendered turbid, by a white powder, ſoluble in acids, and agreeing in its other properties with the compound of phoſphoric acid and lime. The alteration muſt take place in conſequence of the acid, by which the earth was kept in ſolution, being expelled, and the heat does not appear to have been ſufficient for the expulſion of any of the other acids that have been found in the urine. When water, in which magneſia is ſuſpended by means of fixed air, has been expoſed to ſimilar treatment, the carbonic acid is in like manner carried off, and the magneſia ſubſides.

In natural urine, the proportions of alkali or earth, and acids, are accurately balanced, ſo as to form a ſtate of neutrality in which neither is redundant. It is probable that Scheele was miſtaken in ſuppoſing he had obtained the pure matter of calculi by ſimple evaporation, and that the ſubſtance which adhered to the glaſs was that matter conjoined with animal earth. If there was even a ſmall natural redundancy of lithiſiac acid, the effect, which has juſt been related from the application of heat, would furniſh an earth with which it muſt become blended or united. It would probably take the place of the carbonic acid that had been expelled. Either he muſt have evaporated urine in which acid was unnaturally prevalent, as we ſhall often find it under morbid affection, or his concluſion was not perfectly correct. When urine is left to itſelf in cloſe veſſels, we do not ſee any appearance of chryſtals as when an acid has been mixed with it; but there takes place a ſpontaneous ſeparation of a peculiar matter, forming what has been called the cloud. I at one time conceived, that there was adhering to the natural cloud a minute portion of concreting matter, which was depoſited as the urine cooled; I thought it had been in part lithiſiac; but from more nice attention to it, I am now ſatisfied, that when it is not more than what ought to conſtitute the proper cloud, it conſiſts of mucilaginous particles, not in ſolution, even in the body, nor capable, like a lithiſiac ſediment, of being diſſolved by a renewal of heat. It is a gelatinous matter, furniſhed by the paſſages, and only diffuſed through the urine, from which, even in a degree of heat beyond the animal temperature, it may be ſeparated entirely by a filtering paper. Such is not the quality of a lithiſiac depoſite. Frequently, however, when concreting matter is actually redundant, either from an affection within the body, or from an acid having been mixed with the urine, for the purpoſe of experiment, its particles conjoin with theſe of the cloud, which may in this manner be included in the chryſtals. Or the lithiſiac acid and cloud may remain intimately blended in the ſhape of a ſediment, which, under different circumſtances, aſſumes various appearances, and to which much attention has been paid under many conditions of diſeaſe. We ſhall ſoon again have occaſion to mention this kind of ſediment; but having conſidered the natural ſtate of concreting matter in the urine, we muſt inquire into the cauſes of its preternatural ſeparation,

tion, when concretions in the kidnies or bladder are produced.

A condition of neutrality, in which there is a balance between the opponent principles of the urine, appears to be the proper ſtate of that fluid. If there be any natural deviation from neutrality, it is in phoſphorated lime not entirely diveſting of their properties theſe portions of the acids by which it is ſuſpended. Frequently, however, under artificial ſtates of the ſtyſtem, acidity predominates, and the lithiſiac acid appears uncombined with any other matter. When the redundancy is conſiderable, its particles cohere in the body into gravel and calculi. The ſuperabundance, whatever may be its degree, is teſtimony of the infraction of the juſt proportions between acid and alkali or earth. Concerning the production of ſaline matters in the body, we cannot give any information. It has not been aſcertained by what means they are generated, or in what part of the œconomy they are principally formed. Thoſe, which are contained in the urine in much greater proportion than in any other fluid, may be preſumed to be excrementitious, or the ſeparation of them by the kidnies muſt appear an unneceſſary waſte. Of this deſcription is the calculous matter. It is probably one of the ſtates of unſerviceable and excrementitious particles, which are carried off from the circulation by different emunctories. When it preponderates in the urine, we muſt ſuppoſe, that there has been in the body an unuſual production of it, without a correſponding quantity of the matter by which it ſhould be kept in ſolution; or that the portion which is common to the ſyſtem has been thrown into a ſeparate ſtate by the prevalence of ſome other acid. Under the diſeaſe of which we are treating, it is probable that theſe circumſtances are frequently conjoined. To one or the other, and very often to their united effects, the moſt common caſes of gravel are to be aſcribed.

The quantity of lithiſiac matter that can be precipitated from the urine of the proper quality, is in general ſcarcely more than might remain diſſolved in the ſame fluid of the animal heat. For concretion in the bladder, there muſt be a larger proportion; ſo that ſaturation, in the heat of ninety-ſix degrees, ſhall be more than complete. A prediſpoſition then to gravel will attach to that ſtate of habit in which lithiſiac acid is abundant. It may be preſumed, that at the ſame time the other ſaline matters are commonly abundant, and that the reſpective proportions may ſtill be maintained to the preſervation of neutrality. Whatever be the rate of acid, if that of alkali and earth be in an adequate degree, there will be no concreting matter in a ſeparate ſtate. In the urine, while it may be ſtrongly impregnated with the lithiſiac compound, there will not be diſcovered any lithiſiac ſediment. For the formation of gravel there muſt be a preponderating quantity of acid; and when acids ſuperabound, the lithiſiac being the weakeſt, is firſt expoſed to ſeparation.

A high condition, however, of ſaline acrimony, although it may exiſt without prejudice to the habit, while the right proportions are not violated, tends to calculous affection whenever acid happens to prevail. The cauſes of the urine of ſome people being uſually much more loaded with neutral ſalts than that of others, it may not often be eaſy to aſcertain. We cannot always penetrate to the nature and ſources of actions that give occaſion to different conditions and different appearances of the various fluids; but one ſource of difference in the urine, which there is frequent reaſon to remark, is irregularity, or inequality in the operations of theſe organs, by which excrementitious matter is thrown off. There is commonly preſerved a kind of equilibrium between the parts that perform the functions of ſecretion. A decreaſe of evacuation by one gland is often attended with an increaſe of it by another. If the ſurface of the body emits only the thinneſt perſpirable matter without diſcharging its proportion of excrementitious ſubſtance, the urine will convey an undue quantity of the animal ſalts. Sometimes there may be a general diminution of ſecretory functions. Accumulation in the veſſels will then take place; and when the proper action of the kidnies is reſtored, the ſaline impregnation of the urine will be conſiderable. Theſe effects, however, are not ſufficient for the production of gravel. They may only incline to that ſtate of urine in which the proportion of neutral ſalts is ſo large, that, when ſuperabundant acidity, the main requiſite for concretion, is applied, there ſhall be chryſtallization in the uninary paſſages.

For the actual exiſtence of predominating acidity, we muſt ſuppoſe, that there is an augmented rate of the native acids conſidered with relation to that of alkali and earth, or that an acid foreign to the œconomy has been introduced. Concerning the circumſtances which give occaſion to the production of unnatural proportions of acid in the fluids, we are as much in the dark as reſpecting the whole generation of animal ſalts. It is certain that the habit ſometimes inclines to acidity, independent of acid conveyed from the alimentary canal; but that degree of ſuperabundance, which is the ſource of calculous affection, may, in the greateſt number of inſtances, be aſcribed to the preſence of a foreign acid. If any ſtrange acid be received from the ſtomach or inteſtines into the circulation, and ſecreted by the kidnies, it will cauſe in the urine a precipitation of the concreting acid, which, when the proportion is beyond what the quantity of fluid can ſuſpend, will run into a chryſtalline form, while it ſtagnates in the body.

With an excuſe to profeſſional readers for treſpaſſing upon their time by a trivial illuſtration, I muſt explain, for the advantage of others uninformed in every chemical principle, the nature and meaning of precipitation, a proceſs to which there is frequent occaſion to refer. Chemical union is the conjunction of two bodies into a third, with perfectly new and diſtinct properties. It is affected by a certain power which is called attraction, and carries them into combination when they are placed in fit circumſtances for uniting. Such is the power by which magneſia, inſoluble in water, combines with the corroſive vitriolic acid into the common purging ſalt, a compound neither inſoluble nor corroſive, but deliqueſcent in the air, and mild in all its properties. The attraction of any ſubſtance towards others with which it is capable of uniting, is of very different degrees, and ſuſceptible of meaſurement. Its union with one matter will be diſſolved by another, towards which it is drawn by a ſtronger attraction. If a fixed alkali be added to a ſolution of Epſom ſalt, it will combine with the vitriolic acid, from which the magneſia muſt of conſequence be detached, and may be collected in its ſimple ſtate. This is precipitation, and of the ſame kind is the effect of acids upon the urine, in ſeparating the lithiſiac matter.

When we reflect upon the nature and properties of concreting matter, the precipitation of it from the abſorption of other acids muſt appear as obvious as any chemical propoſition. It will be admitted that acids may be abſorbed as readily as many ſubſtances, which are diſcovered in the urine ſoon after having been received into the ſtomach. When they are tranſmitted to that fluid, precipitation cannot be avoided. Eminent phyſiologiſts have been unwilling to introduce chemiſtry into proceſſes within the body. It muſt be allowed, that the natural operations of the ſyſtem, and the actions of the œconomy depending upon life, are not to be accounted for on the principles of that ſcience. But it were ridiculous to maintain that ſalts in the body are defended from the influence of chemical attraction. In the fluids in general, and more particularly in the urine, an excrementitious fluid not veſted with the powers of life, they are ſuſceptible of alteration from acids, and from any other matters by which they would be affected under other circumſtances. Would not a precipitation in the bladder take place, if an acid were to be conveyed to it by the urethra? When we conſider the ready and rapid tranſition of many ſubſtances from the ſtomach to the bladder, there cannot be much difficulty in ſuppoſing, that acids very abundant in the inteſtinal canal muſt be found in the urine. The poſition is ſo obvious, that no man can refuſe aſſent to it without being prepared to deny the poſſibility of acids being abſorbed, and afterwards carried, by the circulation, to the kidnies.

It has been contended, that any quantity of acid or alkaline matter that can be taken up from the ſtomach muſt be too much diluted by the great maſs of circulating fluids, to remain perceptible by its characteriſtic properties. There is fallacy, however, in the argument, and experience is againſt it. The dilution in the blood veſſels is not ſo immenſe as might be at firſt conceived. The blood is known to conſiſt of particular parts, which are compounds of animal matter and water in particular proportions, through which any other fluid can only be diffuſed. A quantity of ſuperfluous water, which contains the ſaline ſubſtances, and probably ſuch foreign matters as gain admittance, appears to be blended, by diffuſion merely, with the whole maſs. A diſtinction of this kind has been made by Dr. Fordyce, of whom, to ſay that he is a profound phyſiologiſt, were but meanly to acknowledge the extent and variety of his acquirements. The kidnies, and the emunctories upon the ſkin, appear to have the faculties of ſeparating the ſuperabundant water with whatever may impregnate it, from the other conſtituent parts of the blood; and by means of theſe properties we can account for many alterations which otherwiſe there would be difficulty in explaining. We learn from them the reaſon of aqueous fluids, that have been drank, paſſing off ſo quickly as is obſerved, and may find encouragement, in affections of the urinary paſſages, for the employment of mucilaginous ſubſtances, which ſome practitioners have been inclined to diſregard, on the ground of their becoming too much diluted to be of avail. The application to the kidnies is ſo frequent, from the vaſt rapidity of the circulation, that almoſt the whole of any fluid fitted for ſecretion by theſe glands, may be contained in the bladder ſoon after it has been admitted into the ſtomach. Secretion by the kidnies has been conſidered as filtration; but it is an elective filtration, by which fluids in mutual diffuſion are ſeparated from each other, and ſome permitted to paſs, while others are retained. If the kidnies have not the power which is poſſeſſed by glands in general, of communicating new properties to fluids by effecting a new modification of elements, they exert an admirable faculty of diviſion, by which fluids that are blended can be withdrawn from each other in a manner that greatly ſurpaſſes any other filtration.

The argument then of extreme dilution, although occurring readily to ſuperficial reflection, is deceptive; and experience, in reſpect to many ſubſtances, ſets it entirely aſide. Particular colours and odours of the urine, from very ſmall quantities of certain matters that have been taken into the ſtomach, are not communicated in an equal degree to all the fluids within the blood veſſels. The matters on which they depend, remain chiefly conjoined with the ſuperabundant water, and along with it are abſtracted by the kidnies. The colouring matter of ten grains of rhubarb, that gives a ſtrong yellow to the urine in an hour or two after it has been ſwallowed, cannot be ſuppoſed to be extended in an equal degree over twenty-five or thirty pounds of fluids. If that were the caſe, the tinge would be of longer duration, and could not be wanting in the urine that is diſcharged for a conſiderable time: it could not vaniſh almoſt as quickly as it had appeared. We ſhall have occaſion, in another place, to ſpeak of the facility with which an alkaline impregnation may be communicated to the urine. In regard to acids, there is more uncertainty on account of another matter by which they are encountered. We ſhall find that the bile has neutralizing properties, and in fact contains alkali in its compoſition. But although an effect upon the fluid in the bladder may not be ſo immediately produced by acids as by alkalis, it is enſured by an habitual and conſtant influx. It becomes certain when acidity is not merely occaſional, but one parcel of acid follows in perpetual ſucceſſion to another, and in quantities beyond what the bile can ſaturate.

Acidity in calculous urine is manifeſt to experiment; and one of the eaſieſt by which it may in general be demonſtrated, is expoſure to a boiling heat. It will not become turbid by a depoſition of animal earth when the fixed air has been expelled. There is preſent, for the ſolution of that earth, a ſufficiency of acid not readily volatile in heat. The balance is not ſo exact, that the expulſion of a little acid vapour gives preponderancy to the earth. Acids of a more fixed deſcription are redundant, and the fluid retains its tranſparency in the greateſt heat it can aſſume. This ſurely is not an equivocal fact. It preſents very ſtrong teſtimony of the ſtate of the urine when gravel takes place, and points with deciſion to the ſource of that diſeaſe.

When the nature even of urinary concretions was unknown, the tendency of acids to produce them had not paſſed unobſerved. Acids and aceſcents have been enumerated, by medical authorities of the higheſt eſtimation, among the moſt active cauſes of gravel. Sometimes in this diſeaſe, the precipitating acid may be the native phoſphoric, muriatic, or carbonic acids, produced by the animal œconomy in increaſed proportion. More frequently it is a foreign acid received by the mouth, or generated in the *primæ viæ*, in conſequence of debility or derangement in the functions of the ſtomach. The diſeaſe does not often occur when the introduction of a foreign acid has not been among the contributing cauſes; and as foreign, I muſt conſider, not only acids that are ſent into the ſtomach, but acid created in the alimentary canal from the digeſtive proceſs being incomplete. Acidity conveyed from the ſtomach or inteſtines, may be diſtinguiſhed as the prime ſource of theſe affections, which proceed from a depoſition of the lithiſiac acid in the urinary paſſages. In many who are ſubject to calculous affection, there is an habitual uſe of acid. Wherever ſour fermented liquors are a common beverage, ſtone and gravel have been obſerved to be more than uſually frequent. In almoſt all, the marks of acidity from imperfect aſſimulation in the ſtomach are not of a doubtful kind.

Many pathologiſts have had an idea that a nucleus was neceſſary for the formation of a ſtone, and invention has been racked to ſupply the probable ſubſtance of nuclei. A nucleus cannot be wanting for chryſtallization in a fluid ſuperſaturated with any ſalt. Dead matter, it is true, affords a ready ſurface for the particles to ſhoot upon; and on this account a chryſtal retained muſt be perpetually increaſing in ſize by the accumulation of redundant acid: it becomes a centre, or baſis of concretion, to correſponding matter. But ſeparation in the beginning is not made in conſequence of a nucleus being preſent. There are at firſt, in moſt caſes, an infinite number of chryſtals which conſtitute that condition of the diſeaſe to which the term gravel is applied. It is fortunate that, in general, they are carried away by the current of the urine, as the ſmalleſt chryſtal remaining muſt become a body, by which in future the precipitated acid will be attracted. The violence done to the paſſages in the evacuation of gravel is a trifling evil, compared to the complicated miſeries attending upon a confirmed calculus.

It is probable that the chryſtallization of concreting matter happens principally during the night, when the urine is at reſt, and retained a conſiderable time before it is evacuated. The ſolution too of ſaline matters in urine ſecreted during the night, is leaſt diluted, and lithiſiac acid is in proportion abundant. The growth of a ſtone will be more or leſs rapid according to the redundancy of acid. The ſhape will depend upon ſituation, and upon the form of the baſis which has been compoſed by the accidental coheſion of chryſtals in the beginning. When two or three cluſters of ſand have been united together, ſo as to conſtitute an irregular nucleus, the ſurface will continue to be irregular, and the lamina will be found to run in an uneven direction. The irritation from ſuch concretions will be greater than from ſmooth ones. The varieties in the colour of calculi, and in the appearance of different lamina of the ſame concretion, may be attributed to ſome adventitious matter attaching itſelf to the redundant acid: but frequently when the ſeeming difference is moſt conſiderable, the compoſition is not eſſentially different in chemical properties. It may be preſumed that concreting acid is commonly moſt pure in calculi that have the neareſt reſemblance to the red chryſtals.

The concreting proceſs is not merely natural and eaſy of comprehenſion, but ſo coincident with experiment, and every part of it ſo much a neceſſary conſequence of what had preceded, that we muſt conſider the general claſs of urinary calculi as fundamentally the ſame. In concluſions, however, that are made with reſpect to animal phenomena, ſome latitude of exception muſt always be admitted. Peculiarities of the œconomy may produce extraordinary modifications of matter, or become the cauſe of concreting acid being connected with ſome other ſubſtance by which its nature and qualities ſhall be diſguiſed. The moſt judicious experiments that were made before the time of Scheele appear under the authority of Dr. Dawſon, in the Medical Tranſactions of the College. The greateſt number of calculi that he examined were evidently of the lithiſiac acid. But from other trials, which are related in a manner that marks clear and faithful inveſtigation, it appears that ſome ſtones, which did not yield much to any alkaline menſtruum, were powerfully acted upon by muriatic acid. In the ſucceeding ſection, I ſhall have occaſion to offer ſome conjecture in reſpect to probable reaſons of difference; it is ſufficient at preſent to obſerve, that theſe peculiar inſtances, which came not under the obſervation of Bergman, Scheele, and others, who muſt be ſuppoſed to have operated upon a conſiderable number of calculi, are only to be regarded as uncommon deviations from a well-eſtabliſhed order. In a work, however, of recent date, a publication particularly demanding attention, on account of the celebrity of its now lamented author, and the ſolemnity of the occaſion for which it was compoſed, the ſpecific diſtinction of lithiſiac matter is attempted to be ſet aſide. It is unneceſſary to add, that the production to which I allude, is Dr. Auſtin's Gulſtonian Lecture. In endeavouring to eſtabliſh a new ſyſtem, it becomes incumbent upon me to ſhew, that other principles ſuſtained with ſo much ability, ſanctioned by ſo much fame, and avowed before the ſupreme tribunal of phyſic, have been ſufficiently weighed. To have paſſed them without regard might be conſtrued into ignorance or diſreſpect. I muſt claim permiſſion to offer a few comments, which ſpring from the particular knowledge that has been communicated in reſpect to the qualities of concreting matter, and its preſence in the urine.

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SECTION III.

On the Theory of Dr. AUSTIN, *with incidental Remarks on calculous Matter and its different Appearances.*

THAT urinary concretions are formed, generally in very ſmall part only, and often in no degree whatever, from the urine as ſecreted by the kidnies, but chiefly from mucus produced from the ſides of the different cavities through which the urine paſſes; and that calculi from the bladder have not that uniformity of property which has been aſcribed to them ſince the time of Scheele, appear to be the main concluſions in Dr. Auſtin's Treatiſe. Calculi he regards as hardened mucus merely, becauſe mucus, a viſcid kind of ſubſtance, approaching ſometimes to ſolidity even upon the ſecreting ſurface, is much more likely than urine to become the compoſition of a calculus, which by ſpecific gravity muſt ſubſide to the depending part, where, for the ſame reaſon, the mucus is accumulated. One ſtone from a calculous patient was immerſed in urine of the perſon who had produced it, and another in mucus ſeparated from the ſame urine. The latter acquired the largeſt increaſe, and the new coat had moſt reſemblance to the matter of calculi. The mucus from another parcel of urine was dried by a gentle heat, and aſſumed an appearance of ſmall ſhining chryſtals, which could not be diſtinguiſhed from the calculi. The hardened mucus and ſtone agreed in chemical properties.

I have been at pains to prove that the urinary calculus is not mucus, but matter of a very different kind, and the experiments appear fully adequate to that intent. The lithiſiac acid, in its ſimple properties, or in any of its combinations, does not evince the leaſt reſemblance to mucus. In all the phenomena from the application of acids and alkalis, there is not a circumſtance that can bring mucus to the recollection. The effect of boiling water is ſtrong evidence in regard to the difference. It is not altered in texture by coagulation in a certain degree of heat, nor does it in the end give the conſiſtence of glue, like every kind of animal mucilage. The water receiving from it only a very ſlight impregnation, is not rendered gelatinous, but remains as thin as before, and even the little that was taken up is depoſited in the cold. The ſolution

lution is incapable of running into the putrefactive fermentation, after the manner of mucilaginous ſolutions of animal matter. The experiments with magneſia and other earths are equally deciſive. Mucus muſt be admitted to be incapable of combining with magneſia, which, with the aſſiſtance of water and heat, is a ready ſolvent for the calculus.

But agreement in properties has been obſerved between the mucus from the the urine of calculous patients and the calculi themſelves. This will not ſeem ſurpriſing to readers who have attended to what was ſaid concerning lithiſiac ſediment. That which has been conſidered as mucus, is in fact principally lithiſiac acid, whoſe particles, in becoming ſolid, have coaleſced with the natural cloud. The ſediment from this conjunction aſſumes wonderful varieties in colour and appearance. Frequently it is lateritious, and the particles of tolerable gravity, ſo as to ſubſide near to the bottom of the veſſel in which the urine is contained. Sometimes it is extremely light and flocculent, giving turbidneſs and ſeeming viſcidity to the whole fluid, while the quantity that can be collected by careful filtration is very inconſiderable. In many caſes it looks like mucus, and not uncommonly it ſettles with the colour and conſiſtence of pus, which, in ſuch inſtances, has been ſuppoſed to proceed from an ulcer in the urinary paſſages. This laſt opinion has been thought to be eſtabliſhed by the cuſtomary fœtid ſmell, and often became a foundation of medical practice. That ungrateful odour, however, is not confined to the appearance of this form of ſediment, but will generally be found to attend a precipitation of the concreting acid. It is, of itſelf, indiſputable teſtimony, not merely of lithiſiac acid being redundant, but of the ſuperabundant quantity having been detached by the proceſs of precipitation from the matter with which it was combined. It is an odour of that kind which is called hepatic, and a ſimilar one invariably ariſes from any urine to which an acid has been added.

It muſt be confeſſed that there is commonly an increaſe of mucus from the irritation of a ſtone upon the inner membranes of the paſſages, and that ſometimes actual pus, from an ulcerated ſurface, may be contained in the urine. Mucus and pus can always be perceived as ſoon as the urine is diſcharged; and their quantities are in many caſes ſo great as to make the water appear very foul and muddy as it runs from the urethra. They are not indebted to a decreaſe of heat for their depoſition. They are in a ſeparate ſtate in the bladder, and ſubſide almoſt immediately.

But a ſediment which has frequently been miſtaken for mucus or pus, is the concreting acid attached to a portion of ſome other matter by which its chryſtallization is prevented. Many who have been diſtreſſed under the idea that pus is blended with their urine, may find comfortable conviction of error from the effect of heat, which will produce the tranſparency that occurs from a lithiſiac ſediment being rediſſolved. *De Haen*, from whom almoſt every principle of Dr. Auſtin is borrowed, has obſerved, that even the urine which he conſidered as loaded with mucus or pus, is commonly tranſparent when diſcharged. He has likewiſe expreſſed his ſurpriſe, that in a caſe where there had been conſtant evacuation of prevalent matter, no veſtige of an ulcer was found on diſſection. The depoſite, it is obvious, was not ſimple mucus or pus, but the proper concreting matter in conjunction perhaps with an increaſed proportion of the mucilaginous cloud, or with ſome other matter which peculiar circumſtances of the bladder had ſupplied. When we are ſatisfied that the ſuppoſed mucus, in which Dr. Auſtin immerſed his calculus, was in fact lithiſiac acid, we cannot wonder that the ſtone received a larger increaſe, than another ſteeped in urine from which the redundant acid had been depoſited.

The urine with a ſediment of the lithiſiac kind is very often diſtinguiſhed by a pellicle on the ſurface, reflecting the rays of light in the ſame manner as oil when poured upon water. The ſame ſort of film, however, is ſometimes found upon urine, in which, without any poſitive prevalence of acid, there is a great impregnation of ſaline matters in general. It proceeds, as upon the ſurface of lime water, from the operation of the air or its contents. The veſſel in which lithiſiac urine has ſtood to become cold, frequently appears lined with a fine membrane, which is ſometimes white, and at other times of a reddiſh caſt. The concreting ſediment is not uncommonly like an earthy matter, and might readily be miſtaken for powdered chalk. In many inſtances it is yellow, and of ſuch a nature as to give to the whole urine the colour and turbidneſs of a cold decoction of Peruvian bark. Another form of it is that of bran, occurring under particular ſtates of fever when it has been called furfuraceous. To enumerate all its appearances were endleſs, although to inveſtigate the cauſes of variety would be an object of importance. That, however, is greatly beyond the preſent deſign. The whole we can pretend to know concerning it, is that lithiſiac acid is commonly the main article in the compoſition; and that the particular forms, which in general have been regarded as ſimple mucus or pus, are often the ſame acid, of which the chryſtallization is interrupted by the coaleſcence of a portion of other matter, that is probably, in principal part, of ſimilar mucilaginous quality with the common cloud. Peculiarities of appearance, under other circumſtances, may depend upon the preſence of matter that is ſupplied under particular conconditions of the ſyſtem, and when the cauſes of theſe varieties are aſcertained, it may prove a better index to the habit than it has hitherto been.

If by accident there be ulceration in the urinary paſſages, the pus may be conjoined with the lithiſiac acid, but the caſes of purulent ſediment are not one in five that have been ſuſpected. If we could trace the reaſon of the ſediment in ſome perſons commonly aſſuming a purulent appearance, we ſhould approach nearer to an accurate knowledge of the cauſes of variety than has yet been obtained; but to pretend to ſay more in reſpect to the auxiliary matter of the compoſition, than that the gelatinous ſubſtance of the cloud is frequently a part of it, were to exceed the limits which examination can warrant. I have thought that carbonic acid, which, when ſtronger acids are redundant, muſt be detached from its combination with animal earth, may ſometimes be conjoined with concreting acid in lithiſiac ſediment, and even in the ſubſtance of calculi. The extreme lightneſs of that ſediment in ſome caſes, where the quantity that gives ſeeming viſcidity to half a pint of urine ſhall be found, when dried, to be but a few grains, when as many drachms might have been expected, induces ſuſpicion of a vapour being connected with it.

In rare inſtances, the ſediment of urine may be calculous acid not detached, but in union with animal earth, or the ſubſtance with which it is naturally combined. The compound, although it unites with water in much larger proportion than the pure acid, may not be ſoluble in ſuch quantity, but that the urine ſhould ſometimes be ſuperſaturated with it. In the plurality, however, of caſes, the lithiſiac portion, or baſis of urinary ſediment, does not appear to be in its proper combination with matter from which it can be detached by acids, but blended with ſomething that has adhered to it after precipitation. And when, from the appearance, the proportion of that other matter might be expected to be largeſt, there ſhall frequently be

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ſcarcely any thing diſcernible to experiment but lithiſiac acid. All the varieties of ſediment not uncommonly occur from the addition of acids to urine when precipitation is undoubted. If the cloud be ſeparated by filtration before an acid is applied, the chryſtals are in general more perfect than if it had remained. If, when it has nearly ſubſided, the tranſparent urine be poured off and an acid mixed with the other part, the precipitate, or a portion of it, inſtead of forming into regular chryſtals, appears often to join with the cloud, ſo as to compoſe a ſediment, which at different times counterfeits many appearances that have been mentioned. A ſediment of this kind I have repeatedly rediſſolved by the application of heat, and ſeldom could obtain a ſecond depoſite under any other form than that of the firſt. Something adverſe to perfect chryſtallization had adhered by a connexion, which a ſmall degree of heat would not diſſolve. In a few caſes I have found that urine with lithiſiac ſediment, after having been expoſed to a boiling heat, has continued tranſparent when cold, without making another depoſite of lithiſiac matter. In ſuch inſtances the ſuperabundance of acid muſt have been inconſiderable, ſo that proper neutrality is recovered by the expulſion of carbonic acid, whoſe place is aſſumed by that portion of lithiſiac acid which had been precipitated and compoſed the ſediment. The phenomenon, however, is convincing teſtimony of the matter of the ſediment having been in a ſtate of precipitation.

Sometimes indeed lithiſiac ſediment will appear to be decompoſed by the addition of an acid, and the urine, which was turbid, ſhall become tranſparent, with a chryſtalline depoſition. From this effect it might readily be preſumed that the ſediment had not been the conſequence of precipitation by redundant acidity, but that the lithiſiac acid was in a ſtate of natural combination with ſome other matter. The alteration, however, may be accounted for in a different manner. The new acid may detach the lithiſiac from its accidental coheſion with the mucilaginous cloud, or with carbonic acid. Yet this is not the moſt probable reaſon. In ſuch urine, and even in urine which a depoſition of red ſand proves to be evidently calculous, the ſuperabundance of other acids in the body has not always been ſufficient for the precipitation of the whole of the lithiſiac acid. Upon an addition of acid there is a freſh depoſite, of which the particles draw within the ſphere of their attraction thoſe of the exiſting ſediment, and the whole coaleſce into chryſtals. The increaſed

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proportion of lithiſiac matter overcomes the obſtacle to chryſtallization. That this is the general cauſe may be deduced from the gradual diſappearance of the ſediment, which does not retire at once, as might be expected if it was decompoſed by the abſtraction of one of its elements. It unites ſlowly into chryſtals with the new precipitate, and ſometimes the chryſtalline proceſs is not complete after many hours. The natural fœtid odour of urine with lithiſiac ſediment, gives teſtimony of precipitation having taken place. When urine of this kind is expoſed to heat of the degree in which water paſſes into vapour, there is not commonly any depoſite of animal earth, as from urine in which acid does not predominate. The emiſſion of fœtid vapour and the abſence of animal earth in a boiling heat, are tolerable criterions of the prevalence of acid. When the ſmell is not offenſive, and the filtered urine becomes turbid as it grows warm, but recovers its tranſparency on the addition of a drop or two of muriatic acid, it may be ſuppoſed that the ſediment was a compound of which the lithiſiac portion continued in its ſtate of natural combination.

There may perhaps be different conditions of foetor in urine from different cauſes. The matter of an ulcer, and other circumſtances, may ſometimes produce an offenſive ſmell, when there has not been any precipitation of lithiſiac acid. The common ſource, however, of fœtor is redundant acidity, and the odour has conſiderable reſemblance to that communicated by aſparagus; but I believe there is not any other analogy. The flavour that is attached to ſome portion of that very excellent and innocent vegetable matter, or the infuſion that is extracted from it by the animal juices, happens to have ſimilitude in ſmell to the vapour which ariſes from urine decompoſed by acids.

The depoſite of calculous urine that has become cold, is frequently red ſand, which leaves the fluid perfectly tranſparent. This is often obſerved to happen when the irritation is ſevere, and a ſediment of mucus might be expected to be conſiderable. By proper regard to ſediments of concreting acid, we ſhall be enabled to account for it, ſo as even to underſtand why the circumſtance may be evidence of the calculous affection being at the time ſevere. It has already more than once been remarked, that for the production of gravel, the redundant acid muſt be in greater quantity than the urine in the body can retain in ſolution. When this is the caſe, chryſtallization takes place in the paſſages, and the particles, in becoming ſolid, frequently attach to themſelves any floating mucus that may be preſent, and adhere with it to calculi or gravel already generated, and poſſeſſing the attraction of dead matter. The urine, when diſcharged, ſcarcely retains the mucus that ſhould form the cloud, but brings along with it the ſabulous matter, upon which that part of the concreting acid ſtill ſuſpended by the heat, is ſoon depoſited in chryſtals from the limpid fluid. Calculous patients frequently take notice, that their ſufferings are leaſt acute when their urine on cooling becomes turbid. The reaſon is explained. The redundancy of concreting acid is not then always ſufficient for chryſtallization in the body, but afterwards conjoins with the cloud, and any other matter that can contribute towards a lithiſiac ſediment. It unites into that condition, with what would probably have been withdrawn from the urine, if a previous depoſite had been made in the bladder.

I may be thought to have dwelt longer than was neceſſary upon ſediments; but the ſubject is of much importance, not merely to the object of the preſent enquiry, but with relation to animal action, and affections local and general; of particular conditions of which, it may, when inveſtigated to the bottom, prove a valuable criterion. Here is in medicine a province which is yet to be explored, and may afford ample field of momentous reſearch to ingenuity and penetration. To look at the urine in diſeaſe, has been cuſtomary ſince the practice of phyſic was a profeſſion; yet, with an exception of very few circumſtances under which ſome knowledge is obtained, it may be aſſerted, that the common regard paid to it has been more for the purpoſe of appearing minute in neceſſary attentions, than from any frequent ability it has afforded of forming indications and prognoſtics. Already, however, the knowledge of ſediments is improving; and under ſound inquiry, in the proſecution of which Phyſiology, Pathology, and Chemiſtry, muſt be in accurate conjunction, while hypotheſis is repelled, it may aſcend to a degree of perfection that ſhall be of great advantage.

As it will now be admitted, that concreting matter is very different from mucus, and that ſediments, which were regarded as ſimple mucus or pus, have frequently lithiſiac acid for their baſis, there can ſcarcely remain a doubt of calculi being generated from the urine. But Dr. Auſtin obſerves, that inſpiſſated urine did not yield to examination by fire that particular ſublimate which was deſcribed by Scheele as a produce of calculi. It has already been remarked, that ſimple analyſis by fire is a means much leſs to be depended upon for aſcertaining the properties of new matter than the relative effects with reſpect to other bodies. The laſt has been the great ſource of vaſt improvements that have been made ſince the time of Boerhaave, who expended much labour to little account in the other way. The ſublimate, as a product which is not furniſhed by animal ſubſtances in general, may be a good characteriſtic of lithiſiac acid; but many are the qualities by which that acid may be diſtinguiſhed from other matter; and none more eaſy or certain than the ſingular alteration in colour to which the ſolution in nitrous acid is liable when expoſed to the air, and when exſiccated. The yellow fluid does not at firſt appear to produce any effect upon the ſkin, or on a piece of glaſs, or a bit of ivory; but after an hour or two the part that was touched looks red, and at laſt it becomes of a blood red, which is eaſily waſhed off. That the experiment may ſucceed, there muſt not be remaining in the ſolution any ſuperfluous nitrous acid. But for the appearance of the red maſs after exſiccation, nicety in ſaturation is not neceſſary, as the ſuperfluous acid is carried off in vapour. The remaining red matter appears to be an acid, and is probably the lithiſiac acid ſaturated with the oxygene of the nitrous acid, whoſe azotic principle has been diſſipated. This is a teſt which makes a ſtrong diſtinction between concreting matter and mucus. It affords a convenient means of marking quantities of that matter too minute to be proved by fire.

Becauſe Dr. Auſtin could not obtain from inſpiſſated urine the ſublimate of Scheele, or was able to procure it in very ſmall proportion only, and under ſuch ambiguity of form as did not permit him to be ſatisfied in reſpect to the identity of properties, he, without heſitation, concludes that the calculous matter which yields a ſublimate is not contained in the urine. It is ſtrange that he ſhould think of demonſtrating by ſublimation, a matter of which there could be but a few grains in an ounce of inſpiſſated reſiduum; and that, upon ſuch ſuperficial ground, he ſhould draw a poſitive inference of calculi not being depoſited from urine. Yet there was no ſublimate from mucus which he is endeavouring to eſtabliſh as the general baſis of calculi. Where then is his argument? and what is the ſource of concretions with ſublimate?

I have proved, by a method much more ſatisfactory than ſublimation, that lithiſiac acid, which yields the proper ſublimate, is always preſent in the urine, from which it may be precipitated in a ſtate of cuſtomary purity. But it were unreaſonable to expect that a ſubſtance, of which the proportion, compared to that of other matters remaining after evaporation to dryneſs, muſt be extremely minute, ſhould be diſtinctly abſtracted from inſpiſſated urine by means of fire. I could ſcarcely hope to ſeparate, in that manner, a particular product of the ſpecific matter of calculi, from a confuſed compound of different ſalts and mucilagnous extract, to the aggregate of which the calculous matter could not bear the proportion of a hundredth part.

The ſublimate of concretions has been regarded with particular attention by Dr. Higgins, who has favoured the world with a ſeries of experiments upon calculi. I muſt expreſs ſurpriſe, that reſolution by fire has been the means of trial principally adopted by that penetrating and expert chemiſt. His proceſſes are elaborate, but have furniſhed an improbable catalogue of extraordinary elements. His obſervations are not ſo ſatisfactory as the general reſult of his ingenious labours. He appears to have conſidered as ingredients that pre-exiſted in a concretion, and not as new products from a different modification of particles, the various ſubſtances he had conceived himſelf to obtain. He regards the ſublimate as the proper calcu-

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lous matter, or the cement of the others, of which the greateſt number are unneceſſary towards concretion, and may be preſent from chance alone. To the ſublimate ſolely he thinks our inveſtigation ſhould be directed, with a view towards the prevention of gravel, and affections that proceed from it. Dr. Auſtin has followed him in theſe opinions, and concludes that the ſublimate is not merely a creature of the fire, or a modification of certain parts of the ſtone produced by heat, and which did not exiſt before the decompoſition of the ſtone, but that it is actually preſent in the ſtone in the ſame ſtate, and that the action of cauſtic alkalis upon calculi is entirely upon the ſublimate.

There is no improbability in this doctrine, nor would the admiſſion of it militate in any reſpect againſt the principles I have endeavoured to ſupport. *A priori* it would not ſeem unlikely, that the calculus may be a volatile body, of which the pure ſpecific matter would aſcend by ſublimation from droſs with which it was accidently connected. But the real effect from fire is entirely different, and although it is painful to diſſent from ſuch reſpectable authorities, there is neceſſity for noticing the error, becauſe it is of that kind from which deceptive practical concluſions muſt proceed. The ſublimate, when in largeſt proportion, ſeldom amounts to much more than half of the lithiſiac matter, as it is found in calculi, or precipitated by acids. The matter with which cauſtic alkalis combine is not this merely, as ſcarcely any thing is left; and upon the addition of an acid it appears ſeparated from the alkali, not under the condition of ſublimate, but in its former ſtate of calculous matter. The precipitate, after refinement by ſolution in alkalis, a proceſs which ſhould abſtract it from the accidental contingent ingredients of Dr. Higgins, will not yield a larger proportion of ſublimate than the original calculus. Sublimate, in a word, is perfectly different from the undecompounded matter of calculi, as we ſhall immediately be convinced.

An immenſe diſtinction in the degrees of ſolubility places the difference beyond diſpute. It is ſtated by Dr. Higgins, that four hundred and twenty grains of ſublimate, the whole produce of eight hundred and forty grains of calculus, were readily diſſolved by eight ounces of hot water; and that after evaporation, till only a ſingle ounce remained, there was not any appearance of chryſtallization, but the ſolution had become thick like treacle. Is this the eſſential matter of calculi—the ſpecific ſubſtance to which attention ſhould be confined in inquiries reſpecting gravel? If it be, where is the difficulty in finding a ſolvent? Or why ſhould we have recourſe to alkalis, when water ſeems to unite with it almoſt without becoming ſaturated? The ſublimate, like the calculus, diſſolves in lime water and alkalis; but the compounds are as different as any ſolutions of different ſalts.

I am not afraid to renew my aſſertion, that the concreting acid is a body, of which the hidden elements are as much conjoined into an uniform compound as in the ſublimate itſelf. The laſt is as different from the original maſs as many other products of fire from the ſubſtance, by which, in conſequence of a new modification, they are yielded. It appears as much a compound body as the entire lithiſiac acid, and, in the fire, gives out a new ſublimate, as different from itſelf as both are from the calculus. In each proceſs there is obvious decompoſition; and if our attention is ſolely directed to either of the products, in preference to the whole bulk of concreting matter, we ſhall contract falſe notions of the nature of calculi. The ſublimate is probably a new product from conjunction of elementary principles of the ſtone in a new form. If it pre-exiſts in a concretion, it is to be regarded not as blended merely with accidental matter of different kinds, but combined by the moſt intimate chemical union with all the other elements, into a compound which operates as a ſimple body upon many other matters, and, in pathological inveſtigation, is chiefly to be conſidered in its compound ſtate. By examining the ſublimate merely, or any other of the products from analyſis by heat, we ſhould acquire as little knowledge concerning the aggregate body, as reſpecting ſugar from attention to its acid alone.

Dr. Auſtin having taken the production of calculi with ſublimate from the urine, and left it entirely unſettled, gives an account of a calculus which was proof againſt the operation of alkalis, and did not by ſublimation yield the uſual product. That there muſt have been ſomething particular in this concretion is evident; and it is to be lamented, that his experiments upon it did not extend to a more perfect examination of its nature. The alkali was employed in a ſtate of extreme dilution, the proportion being only a drachm of ſoap-lees to half a pint of water. For the ſolution of any calculus in ſuch a mixture, a boiling heat will be required, or the concreting matter in fine powder muſt be kept in repeated application to the ſcattered particles of the alkali, by ſtrong and conſtant agitation. If a lump of calculus be thrown into lime water, or diluted alkali, the fluid on the ſurface of the ſtone becomes ſaturated in a ſhort time, and no air being extricated to keep up inteſtine motion, would for ever defend the remaining matter from the action of the ſolvent. Yet there has been nothing more common than to pronounce upon the operation of menſtrua upon calculi, by throwing a piece of concreting matter into a fluid, and leaving it at reſt for a few days. It may alſo be obſerved, that experiments upon urinary ſtones ſhould be made while they are recent. The red ſand precipitated by acids, appears more difficult of ſolution, and leſs perfect in its general properties, after long expoſure to air.

The trials with alkali and lime-water are not related in a manner that gives perfect ſatisfaction, but the peculiarity of the ſtone in queſtion is evinced, not merely by the abſence of any ſublimate, but by the largeneſs of the reſidue after a great degree of heat had been applied. Sixteen grains were left of twenty that had been employed. It is evident, the *caput mortuum* of mucus could not be in this proportion, therefore the experiment is equally fatal to Dr. Auſtin's favourite hypotheſis, with an examination of calculi that furniſh ſublimate. Neither is mucus incapable of being acted upon by cauſtic alkalis, nor does it diſſolve ſo readily as the lithiaſic matter in nitrous acid, which was a ready menſtruum for this ſtone. It is extremely to be wiſhed, that the concrete itſelf had been examined by different means, or that the extraordinary reſiduum had been put to ſome other trial ;—a reſiduum concerning which we may declare with certainty, without any other knowledge of it than its quantity, that it was not derived from mucus.

It appears that the ſtones, which in Dr. Dawſon's analyſis did not yield in any conſiderable degree to cauſtic alkalis, were acted upon by muriatic acid, which towards proper lithiſiac matter is inert. It ſeems probable therefore that there are calculi of which the compoſition is in part an earthy matter ſoluble in that acid. A concretion which principally conſiſted of animal earth would not diſſolve in alkali or lime-water, or ſuffer much change in the fire ; but Dr. Auſtin has joined with recent inveſtigators in exploding the idea of calcareous ſtones, and does not appear to have made uſe of muriatic acid upon calculi, which carry not any character of mucus, yet were inſoluble in the common menſtrua.

We ſhall find hereafter, that there are circumſtances under which animal earth may predominate. Its particles may perhaps ſometimes cohere in the bladder. I am inclined to think that there are inſtances of calculi, of which the principal part is an earthy matter ſoluble in common acids. I have had an opportunity of meeting with one caſe which appeared to be of this deſcription. The urine, as it paſſed from the bladder, looked commonly very foul and turbid, from a profuſion of mucus, in which were involved many ſhining particles different, to examination, from the common calculous ſediment. Sometimes a conjunction of theſe particles had taken place ſo as to form little concretions. This kind of gravel was ſtrongly acted upon by muriatic acid, from which, after its operation, an earth was precipitated by alkalis. A part that had been left by the muriatic acid, was the proper lithiſiac matter, and united readily into the characteriſtic ſolution with nitrous acid. I ſuſpected the compoſition to be phoſphorated lime combined with carbonic acid, and attached to a portion of lithiſiac matter which had been precipitated by prevalence of the ſame aerial acid. There was not probably any chemical conjunction between the earthy and lithiſiac portions, or the compound would have been ſoluble in the urine. Effervеſcence, during the ſolution in muriatic acid, indicated the preſence of carbonic acid, a ſuperabundance of which will not only account for animal earth and lithiſiac acid being together redundant, but may, even allow an aerated alkali to prodominate at the ſame time. Mild volatile alkali ſeemed actually to be blended with the fœtid vapour that aſcended from this urine, of which the fumes, mingling with thoſe of muriatic acid, compoſed the white ſmoke of ſal ammoniac. Its condition appeared to have ſome relation to the effect, which would ſucceed to a ſolution of mild volatile alkali being dropped into urine in which lithiſiac acid was redundant. That acid and animal earth would be mixed together in the ſediment.

Such mixed caſes may ſometimes occur, but are ſo much leſs frequent than others where the compoſition is almoſt entirely lithiſiac acid, that I ſhall continue to treat of gravel and calculi as conſiſting of the ſpecific matter merely, without regard to anomalous inſtances, which attention to the urine muſt detect. Dr. Dawſon has ſtrenuouſly urged a ſtrict examination of the urine, and of the ſand, or fragments of ſtones that are diſcharged. It is probable his calculi, upon which muriatic acid took effect, were in part lithiſiac, as that acid never diſſolved the whole, and ſometimes not more than half of the concretion. The colour he deſcribes, which was like that of red tartar, produces conviction of a portion of lithiſiac acid being preſent. One would expect moſt frequently to find earth in thoſe that have the whiteneſs of chalk ſtones; yet very often they are of the ſimple kind. The exceptions to the general character of calculi make in the diſeaſe a variety, which in practice is not to be overlooked. There are few morbid affections of which the general ſtate does not admit of exception.

In reſpect to the ſources of variety, or the difference of properties in calculous matter, we cannot derive any information from Dr. Auſtin, who appears to have referred both deſcriptions to mucus, while his experiments are only ſufficient for demonſtrating, that the nature of both was very different from that of mucus. He contends, that with regard to calculi which contains the ſublimate, it has been proved that nothing can be diſcovered in the urine to account for their formation. That ſublimate cannot perhaps be made obvious, by the proceſſes he purſued, from the incruſtations of dark alleys and convenient corners, or from the whole heterogeneous reſiduum of inſpiſſated urine. But if he had been acquainted with the effects of acids, he would have known a method, not elaborate or liable to miſtake, of ſtriking from urine a ſubſtance which will yield the peculiar ſublimate in perfection: and his obſervations might have taken a direction which would not have tended to throw back, into its priſtine ſtate of night and obſcurity, a ſubject upon which light was beginning to be diffuſed.

It ſeems unneceſſary to adduce farther evidence of concreting matter being depoſited chiefly from the urine, as a method of unambiguous demonſtration within the reach of every perſon has been given. Twenty drops of diluted vitriolic acid, or a few drachms of vinegar, added to half a pint of morning urine, will produce ſatisfaction of the conſtant preſence of lithiſiac matter, and the ſame experiment will exhibit the general fœtor of nephritic urine, with ſometimes a ſediment not unlike to mucus or pus. One or two remaining arguments, however, on the other ſide, require to be noticed. Conſiderable ſtreſs is laid upon the incruſtation of ſolid ſubſtances introduced by accident into the bladder, and upon the manner in which the depoſite is ſometimes obſerved to be made in cyſts, or between the coats of the ureters and bladder.

It has been long remarked, that the end of a catheter, continuing for a length of time in the paſſage, was apt to acquire a cruſt of concreting matter, and that a bougie, having got into the bladder through misfortune or inattention, became the nucleus of a ſtone. Theſe circumſtances have been brought forward in ſupport of of the calculus being mucus, of which the ſecretion was increaſed by the irritation of a foreign body. A more accurate knowledge of concreting matter compels us to reject the concluſion, although we may be unable to account for the effect on ſatisfactory grounds. If it were even admitted, that the largeſt portion of lithiſiac acid does not paſs the kidnies with the urine, but is furniſhed by the bladder, that acid would not be leſs diſtinct from mucus. It will ſoon appear that a part of it may actually be introduced into the bladder in this manner, but a part that is inconſiderable compared to that which comes along with the urine. It were an improbable conjecture, that a matter, which is always in uniform ſolution in the urine, except when it has been ſeparated by the manifeſt prevalence of ſtronger acids, ſhould not be tranſmitted with that fluid by the kidnies, but taken up from the inner membranes of the bladder, which is intended to be a mere receptacle for the ſecreted urine—a bag whoſe ſole function, independent of thoſe that are requiſite for its own exiſtence, is the faculty of diſcharging its contents in obedience to the will.

Lithiſiac acid is not the produce of diſeaſe, but an integrant part of the urine. It is the deviation from neutrality, which exhibits that acid in a ſeparate ſtate, that is diſeaſe, or a conſequence of diſeaſe. Of that habitual deviation which becomes the cuſtomary ſource of concretion, we have been able to aſſign the moſt frequent cauſe: it is ſuperabundant acidity from unnatural influx of acid. But it was confeſſed that infringements of the balance, which, however, are generally leſs conſiderable, happen from other cauſes that are myſterious and obſcure. We cannot penetrate to the reaſon of urine retaining its natural neutrality during the cold fit of an intermittent, and betraying redundant acidity as ſoon as the criſis has taken place. Retention of lithiſiac matter, in conſequence of the ſecretory veſſels being contracted during the firſt ſtage of fever, is not an adequate illuſtration. It will not entirely account for a change that indicates an alteration of porportions between the elementary ingredients of the urine. The fluid, which during fever does not depoſite a ſediment, frequently contains abundance of lithiſiac acid in natural combination, and capable of being precipitated by acids. The ſimple lithiſiac acid, which afterwards forms the critical ſediment when acidity preponderates, is as much in ſolution in the body as the lithiſiac compound, and might as readily paſs the kidnies if it were preſent. Mere retention, by which bodies chemically united are equally withheld, will not explain appearances which depend upon inequality of proportion. Retention will not account for the lithiſiac ſediment and fœtid odour of urine, after extraordinary exerciſe, or a great degree of fatigue; yet unuſual exertion, ſuch as that of riding to a man who has not lately been on horſe-back, is one of the moſt frequent occaſions of acid becoming for a little time redundant, and diſplaying itſelf in the urine.

There is indeed one acid in the fluids, the carbonic, of which the quantity preſent may perhaps be particularly increaſed by retention. From the great propenſity of this acid to unite with the matter of fire into vapour, it might be ſuppoſed that a portion of it is generally flying off from the body by inſenſible perſpiration. It may eſcape from the fluids expoſed to the common atmoſphere on the ſurface, or in the lungs. When from contraction of the exterior order of veſſels, or a diminution of external circulation, exhalation is ſuſpended, it may accumulate ſo as to give a habit of prevailing acidity.

Here would be a retention not only of ſalts in general with which neutrality might not be incompatible, but of acid in particular, that muſt immediately predominate. The principle is not perhaps without foundation, and would account for many inſtances of ſuperabundance; there are others to which it could not be applied. The Economy, by its inherent laws, ſeems to be diſpoſed to acidity under particular circumſtances, among which may be enumerated irritation in the urinary paſſages. We cannot arrive at a complete knowledge of the cauſe, but reaſons which probably contribute towards it may be ſuggeſted.

Between the ſtomach and the urinary paſſages there is an exquiſite ſympathy, that has conſiderable influence upon digeſtion, with which the preſence of a foreign acid, and perhaps the quantities of native acid are connected. Irritation in the parts which are concerned in tranſmitting the urine, is generally accompanied with diſorder in the viſcera that occupy the higher region of the abdomen, and in proportion as aſſimilation is incomplete, acidity will be apt to be redundant. The functions of the liver, which will be found to be a grand regulator of acidity, are for the ſame reaſon diſturbed; and the general ſurface of the body is not unaffected. There will commonly be occaſional rigours and other ſymptoms of univerſal derangement. The febrile condition that takes place from the uneaſineſs endured, occaſions contraction of the extreme veſſels, which may ceaſe to tranſmit their proper portions of excrementitious matter, while from near connection there is an increaſed action of the kidnies, by which a greater proportion, of what ſhould have been diſcharged by different emunctories, may be carried off. The ſecretion of urine by the kidnies is not leſs influenced by irritation in the paſſages, than that of mucus from the glands which open into the bladder.

It may likewiſe be obſerved, that the accidents, from which the argument is drawn, cannot be ſuppoſed to occur to a perfectly ſound habit. There muſt have been ſome pre-exiſting irritation, or antecedent diſeaſe, to require the application of a catheter or bougie. Many have ſuppoſed, that any ſolid body kept as a nucleus in natural urine frequently renewed, would become incruſted ſo that a ſtone ſhould be formed. This is one of the numerous falſe opinions which, originating from hypotheſis, or gaining footing from looſe obſervation and vague experiment, have continued to be received as if reſting upon an eſtabliſhed baſis. In proper urine there is not in cloſe veſſels a particle of concreting acid depoſited, the whole of that acid being in perfect ſolution. On the contrary, ſound urine of the animal heat, is capable of taking up a ſmall portion of calculous matter, ſo as to become a menſtruum for a ſtone. The only ſpontaneous ſeparation from ſuch urine is the natural cloud, which cannot produce a calculous cruſt. If a ſolid body be kept in urine in which acidity is redundant, or to which an acid has been added, it will be incruſted. Even then, however, the formation of a ſtone will be very ſlow, as the attraction of the ſides of the containing veſſel to the lithiſiac matter is as ſtrong as that of the intended nucleus, and the comparative ſurface greatly multiplied. But to the end of time there would not be a calculus from renewed applications of urine in which acid does not predominate, to a nucleus ſuſpended in a veſſel from which the common air was excluded. If there be free communication with the atmoſphere, decompoſition may enſue from the operation of the air, or of carbonic acid upon an extended ſurface.

When a foreign body gets into the bladder, if it meets not with acidity already redundant, it probably would operate by irritation, ſo as to occaſion redundancy. The conſequent acidity may be an effect of general ſympathy diſpoſing to ſuperabundant acid in the ſyſtem, or it may be a partial alteration in the urinary fluid from diſordered functions of the parts concerned. As modes of univerſal action can frequently incline the univerſal habit to predominating acidity, peculiar directions of local operation may give prevalence of acid to a particular ſecreted fluid, while neutrality is preſerved in the œconomy at large. When lithiſiac acid is redundant in the bladder, the petrifying proceſs will make rapid advances upon a foreign body, whoſe attraction to concreting particles will not be divided by the living membranes, as by the inner ſurface of a bottle. But a piece of a bougie, if it were to get into the bladder of a perſon, the ſtate of whoſe urine is perfectly natural, muſt operate to the production of different qualities in that fluid, before it can be incruſted. When the misfortune has occurred, the urine has uſually been before in a ſtate too much adapted to incruſtation. The diſeaſes which require catheters and bougies, are almoſt uniformly accompanied with prevalence of acid, from the general and particular ſympathies by which they are attended.

The laſt thing to be mentioned is the appearance of calculi in cyſts, and the depoſitions of concreting matter between the coats of the ureters and bladder. Cyſts containing calculi, have been conſidered by the beſt anatomiſts, as protruſions of the inner membrane between faſciculi of the muſcular coat of the bladder. It is not difficult to conceive, that ſuch protruſions, forming a kind of *herniæ*, may happen in ſtrong ſpaſmodic contractions upon ſmall calculi. Dr. Auſtin employs ſome argument againſt this being the general cauſe; but the nature of the phenomenon appears well eſtabliſhed.

For depoſition between the coats, or in the ſubſtance of parts, we muſt have recourſe to another principle, to which alluſion has already been made. The circulating fluids are to be regarded as capable of throwing off concreting matter, and while it is contended that the principal part of that contained in the urine is tranſmitted by the kidnies, it will not be denied that a portion may be conveyed into the urinary paſſages with the fluids, which paſs from numerous minute glands on their inner membranes. A depoſition may take place within the blood veſſels themſelves, or in cellular membrane, the connecting medium of the body, or in the excretory duct of any gland. From the matter ſo depoſited, an affection of a peculiar nature is frequently excited, and that affection is GOUT.

SECTION IV.

On the Cauſe and Progreſs of Gout.

PHYSIOLOGISTS, who have made chemical examination of the blood, are of opinon, that the ſaline ſubſtances of the urine may be detected in other fluids of the body. Ammoniacal and ſelenitic ſalts are not the products merely of ſecretion by the kidnies, but may be ſeparated from the blood. It may be preſumed that lithiſiac acid is likewiſe preſent in the circulation. To demonſtrate the exiſtence of it in blood drawn from a vein, were, for ſeveral reaſons, an undertaking of great difficulty. The proportion compared with the whole maſs muſt be extremely minute, as the ſuperfluous water which contains the ſalts, and from which the urine may be ſuppoſed to proceed, is in diffuſion through the other conſtituent parts of the blood, the lymph, the ſerum, and the red particles. If coagulation be employed, as a means of abſtracting from this compound fluid its mucilaginous matter, of which the quantity is extremely unfavourable to chemical experiments, the water that is thrown out unites with that in which the ſaline ſubſtances are diſſolved, and the dilution is greatly increaſed. When I formerly preſumed to publiſh my ſentiments upon this ſubject, I thought I had been able to obtain concreting acid from ſerum, but now, after many varied attempts, I am not ſatisfied with my ſucceſs. A frequent depoſition, however, of that acid in different parts of the body, affords indiſputable teſtimony of its being contained in the general fluids. It is a morbid depoſition occurring under particular circumſtances, and the ſtate of the ſyſtem in which it is moſt commonly obſerved, appears to be an inflammatory affection of a peculiar nature, diſtinguiſhed by the name of Gout. An inquiry then is natural, whether that affection be the conſequence of concreting matter being redundant, or the coincidence merely accidental.

For information on this point, the general condition of the habit in gout muſt be conſidered; and here I muſt recur to that obvious connection, which every attentive obſerver has marked between gravel and gout. The conſtitutions, the cauſes, and the remedies have appeared to be allied. The ſuperabundance of lithiſiac acid ſometimes becomes apparent, by being depoſited in maſſes, that differ not conſiderably from urinary calculi. More commonly it is not collected in ſuch ſeparate quantities, but to a fit of the gout ſucceeds rigidity of tendons and ligaments, as if from diffuſion of lithiſiac matter—a rigidity, not proceeding from tenſion in conſequence of muſcular contraction, but ſeemingly occaſioned by an alteration in the parts themſelves, as if from an accidental depoſition of ſomething on the ſurface, or temporary intervention of foreign matter between the fibres. A tendon in the palm of the hand ſhall be felt almoſt as rigid as bone, while the flexor muſcle to which it belongs is in a ſtate of perfect relaxation. The uniform occurrence in ſome degree of ſuch alterations from gout, conjoined with an evident depoſition of lithiſiac acid in many caſes, conveys more than ſuſpicion of the diſeaſe being connected with a redundancy of that acid. The phenomena too of the diſeaſe will be found more correſpondent with that opinion than with any others of the numerous vague and viſionary theories that have been advanced: for vague and viſionary beyond even the common latitude of medical unpreciſion, may be conſidered much of what has been written concerning the cauſe of gout.

The parts moſt frequently affected are theſe, which might chiefly be expected to ſuffer from concreting matter redundant in the circulation. A depoſition of ſuch matter will be moſt likely to occur in organs whoſe veſſels are of the ſmalleſt order, and whoſe diſpoſition is inert. Of this deſcription are tendons and ligaments. Their veſſels, in natural dimenſions, are too minute to admit the red particles, and perhaps other component parts of the blood; and their texture is ſo tenſe that they cannot, without conſiderable violence being employed, allow of any increaſe of ſize, while, from their ſtate of indolence and inaction, they are without a ready means of occaſionally applying additional force for the purpoſe of maintaining the freedom of the circulation. The redundant acid yet in ſolution in the water of the blood may inſinuate itſelf into the veſſels of ſuch parts, and ere by a ſlow and languid circuit it can eſcape, a portion of it may have been depoſited. The very ſmall particles already in a ſolid ſtate, being compreſſed by the decreaſing magnitude of the capillary canals that convey it, may be arreſted on the ſurface, or detained within the ſubſtance, till by accumulation, rigidity takes place, or little calculi are formed. Such alterations cannot continue without derangement in the functions

tions of parts. Symptoms of local diſorder and univerſal ſympathy enſue, until by that admirable faculty which has been ſtiled the *Vis Medicatrix*, or nature's means of relieving herſelf from morbid oppreſſion, the powers of life are rouſed to an increaſe of exertion in proportion to the neceſſity, and the offending evil is overcome. The inflammation of gout appears to be nature's remedy for the diſorder that had taken place.

A want of freedom in the circulation is ſo much indicated by circumſtances that have relation to the taking place of gout, and by appearances under the affection itſelf, that the diſeaſe has by many before this time been conſidered as proceeding from obſtruction in the veſſels of the part affected; and the obſtruction has frequently been attributed to ſomething that was termed gouty matter. In books of medicine we are perpetually reading of this matter, yet there is not in phyſic any other expreſſion of which the meaning is leſs determined. The ideas concerning it were ſo various, and opinions ſo very different, that of late it has been entirely rejected by the moſt eminent of the profeſſion. They are unwilling to admit the influence of a matter reſting upon ſuppoſition merely; for it is contended that no proof has been adduced of its exiſtence; and they have combated the doctrine, by oppoſing to each other the contradictory ſentiments, in reſpect to its nature, of thoſe who ſupported it. The objections were undoubtedly of weight, but they are now removed. The concreting acid to which we have aſcribed the effect, is not a viſionary matter. From requiring for ſolution a very large quantity of water, and from its tendency to be depoſited in a chryſtalline form, it is a ſpecies of matter extremely adapted for producing obſtruction in the veſſels of a living animal. It is an obſtructing matter, not ſpringing from hypotheſis, like many ſuppoſed cauſes of obſtruction, but of ſuch a nature as to be readily comprehended in its operation and effects.

The alteration is indeed obvious and convincing. When the redundant acid ſhall be more than is ſufficient for ſaturating the aqueous portion of the fluids, there would be difficulty in ſuggeſting any means by which its concreting tendency ſhould be counteracted. If it gets into a ſtate of ſolidity, it cannot be ſuppoſed to continue in the body with impunity to the ſyſtem. When we conſider the indolent condition of many parts, and the extreme minuteneſs of their veſſels, it will appear impoſſible that a matter of this kind ſhould be received into them without

out producing interruption and derangement. The coaleſcence, even in the blood veſſels, of the particles of particular kinds of matter from the ſtate of ſolution to that of a ſolid, cannot be thought improbable. If acid of ſugar, which with ſuperior attraction to that of acids in general, ſeizes upon calcareous earth, and combines with it into an inſoluble compound, were to be received into the ſtomach in ſuch quantity, that a portion unſaturated ſhould get into the circulation, could any man entertain a doubt of the formation of ſaccharated lime, which, by accumulation from a continued influx of the ſame acid, might produce depoſition and conſequent diſorder, analogous perhaps to gravel in the urinary paſſages, and to gout in other parts? It ſeems probable, that particular effects of other ſubſtances might ſometimes be accounted for on a ſimilar principle. *Terra ponderoſa*, which in the change it undergoes from fire, and in ſome of its combinations, has ſo much reſemblance to calcareous earth, as for a long time to have paſſed undiſtinguiſhed from it, unites, by an attraction ſuperior even to that of alkalis, with vitriolic acid, into a compound which water does not diſſolve. If a ſolution of it in any other acid be mixed with water containing vitriolic acid, by itſelf, or in conjunction with any other matter,

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the vitriolated *terra ponderoſa*, or barytic ſelenite, will immediately be formed. This earth has been found to have upon the ſyſtem greater effects than might be expected from its agreement with lime in many reſpects. Perhaps its potency may in ſome degree proceed from its meeting with vitriolic acid, of which a portion has been ſuppoſed to appertain to the body. The ſolutions of lead are decompounded by the fluids, as may be proved by mixture with urine or ſaliva, and a white concrete precipitate is produced. It ſeems not improbable, that the medicinal or deliterious effects of ſuch articles may be in part owing to their tranſmutation in the abſorbents, the blood veſſels, or the organs of ſecretion, and to the interrupted functions of parts from the unnatural and perhaps mechanical influence of ſtrange particles. In the firſt volume of the Medical Tranſactions, there is annexed to a paper upon the effects of lead, by the preſent diſtinguiſhed Preſident of the college, an account of alteration in the appearance of muſcular fibres in bodies which had been expoſed to the influence of lead—an alteration to which nothing ſimilar is perceived in common paralytic caſes. The peculiarity, equally claiming credit and regard from the anatomical acuteneſs of Mr. Hunter, the gentleman who made the obſervation, and the great profeſſional bility, as well as pre-eminent reputation for general learning and claſſic endowment of Sir George Baker, by whom it is recorded, might be thought favourable to the idea of depoſition of the particles taking place. Prudence will deliberate upon the admiſſion into the ſtomach of articles, which paſſing unſaturated, or undecompoſed by the digeſtive fluids into the vaſcular ſyſtem, muſt be acted upon by matters in the circulation, ſo as to form ſolid compounds, from which ſerious evil may be apprehended. Acid of ſugar, as an acid, is mild and grateful to the taſte, but a man acquainted with its characteriſtic property that has been mentioned, would be intimidated from a long-continued exhibition of it. He would not employ it as a cuſtomary ingredient in his punch.

The conſequence of concreting acid becoming redundant, is of the ſame kind ; and, as was ſaid in regard to gravel, if the proportion precipitated be more than can be retained in ſolution, the particles muſt be depoſited, and that depoſition becomes the cauſe of gout. In attributing this diſeaſe to a redundancy of acid, we are enabled to eſtabliſh its primitive ſource, and the operation of its cauſe upon the ſyſtem. I am perſuaded that the production of it will in future be conſidered leſs intricate than that of the greateſt number of morbid affections.

The depoſition may take place in any part of the body. There is not a ſituation where gouty affection does not occaſionally occur. Lithiſiac acid has frequently been diſcovered in the lungs, and within the excretory ducts of many glands. We cannot now have difficulty in accounting for it between the membranes of the ureters and bladder. Some part even of that contained in the urine may be thrown into the bladder, with fluids which proceed from glands that open into it, and that quantity may be preternaturally increaſed by irritation. Secretions in general, when under a ſtate of irritation, appear to be more than uſually impregnated with the native ſalts of the body, and from this cauſe principally has ariſen the idea of acrimony. There is not, however, any fluid, in which the proportions of this and other ſaline matters are ſo great, as in that ſecreted by the kidnies. Red ſand depoſited from the urine in the very act of ſecretion has often been found in the *tubuli uriniferi*. A caſe is reported by *De Haen*, where the whole ſubſtance of theſe glands was loaded with this matter, which in the particular inſtance of this patient, who was ſeverely afflicted with arthritic affection, he conſidered as the matter of gout paſſing off by the kidnies,

kidnies. It may be remarked, that in the ſame inſtance, the urinary ſediment had been ſuppoſed to be purulent, yet upon diſſection there was not found any ſource of pus. He wanted but a knowledge of the nature of concreting matter, its common condition in the fluids, and the uniformity of its properties, to have eſcaped from his errors, and penetrated to the origin of both diſeaſes. It is evident that a depoſition of the ſame kind may take place in the capillary veſſels of any other part. The redundant acid may be thrown out on the ſurface of the body, and appears ſometimes to be an occaſion of diſorder upon the ſkin. It may be obſerved, that the vapour from the body during a complete fit of gout, is ſtrongly impregnated with that particular fœtor, which occurs when lithiſiac acid is precipitated from urine, and that it has been found to poſſeſs the property peculiar to acids, of turning to a red colour the juice of certain vegetable productions.

The lithiſiac acid, detatched from its natural combination by the prevalence of ſtronger acids, may adhere to any fibre, or be conveyed into any cavity; but the places where a depoſition would be expected, are exactly thoſe which are moſt ſuſceptible of gout. The common ſituations of that affection are tendons, ligaments, and membranes, which are expoſed to ſuch alterations from reaſons already ſtated. They are liable to be the ſeats of depoſition, from the contracted dimenſions, unaccommodating texture, and indolent condition of their veſſels, while the different ſtate of their contents from thoſe of larger veſſels prediſpoſes to the ſame end. The fluids of theſe parts, abſtracted by a filtration which the body alone can effect, from the red matter and much of the mucilaginous ſubſtance of the blood, approach nearer to the nature of urine, and are principally the ſuperfluous water with the ſalts that belong to it. They may be regarded as ſecretions from the general maſs, and equally expoſed to the action of acids, with the ſecretion by the kidnies.

That acids are greatly inſtrumental towards the production of gout, is an opinion which was founded upon obſervation, and has long been maintained. This diſeaſe, as well as gravel, has in many caſes been attributed to an exceſſive uſe of acids. It has likewiſe been regarded as intimately connected with that ſtate of ſtomach, in which there is an almoſt perpetual generation of acid. At the ſame time, however, a variety of circumſtances of a different kind have been enumerated as ſources of it. If we examine with attention the condition of many in whom gout makes its appearance, we ſhall generally find, that thoſe other circumſtances have chiefly been productive of it, when they have had the previous effect of impairing the digeſtive faculties, and cauſing a conſequent tendency to the generation of acid. Of this nature are inſobriety, luxury, indolence, and voluptuouſneſs. The diſeaſe frequently attends upon a habit of drinking, on account of the acids conveyed into the body by means of it. The tendency of different liquors to produce it, is not ſo much in proportion to their ſtrength, as to the quantity of acid in their compoſition. This aſſertion is warranted by the experience of ages; the liquors in which acid predominates having been invariably conſidered, by the beſt authorities, as peculiarly prediſpoſing to gout. Shallow of obſervation muſt be the man, who, accuſtomed to endure the pains of gout, has not become acquainted with the injury of acids. By immoderate indulgence in intoxicating compounds of any kind, by a life of luxury, by a ſtate of indolence, and by an inordinate purſuit of pleaſures, the powers requiſite for the proceſs of digeſtion are at laſt brought into diſorder, and the contents of the ſtomach permitted to run into common fermentation. Theſe and other circumſtances, which tend to vitiate the action of the ſtomach, and conduce, by reaſon of derangement, to the formation of acid, may be looked upon as remote cauſes of gout and of gravel.

Gout is one of the diſeaſes which has the appearance of being tranſmitted by parents to their offspring. This circumſtance may be advanced as an argument againſt its proceeding from the introduction of acids, but on reflection will be found to give weight to that opinion. In the multitude of affections depending upon peculiarities of habit, there is not one more uniform in its occurrence than that diſpoſition to ſtomach derangement which is the ſource of much diſorder in the ſyſtem. The features of the face, the propenſities of genius, the nature of the paſſions, or the diſpoſition of the mind, have not greater reſemblance in conſanguinity than the condition of the ſtomach. A conſtitutional imperfection in the digeſtive faculties, or that condition of ſtomach in which a part of the food is perpetually running into theſe fermentations which produce acidity, is a great hereditary ſource of gravel and gout.

A defect in the digeſtive proceſs frequently ſucceeds to irregularity, to intemperance, and to unavoidable expoſure, under many ſituations, to circumſtances that are the occaſion of debility and diſeaſe. In a great number of habits, however, there is original and conſtitutional imperfection, which may be marked even in the earlieſt periods of life before any morbid temperament has been contracted, and is found in the advanced ſtages to become greater with increaſe of years. Frequently it is accompanied with general debility and univerſal delicacy; but not leſs commonly it is an attendant upon habits that are otherwiſe robuſt. In men of coarſe fibres, large bodies, and great apparent ſtrength, a natural tendency to indigeſtion is not a rare occurrence; and the appetite is often immoderate, while the powers of aſſimulation are very limited. In ſuch habits there is apt to be plethora from irregularity of ſecretion. When the functions of the ſtomach are not properly performed, thoſe of the emunctories are ſeldom complete. From defect of perſpiration there is dryneſs upon the ſkin, and retention of what ought to be diſcharged; redundant acid accumulates, and at the ſame time there is general fulneſs prediſpoſing to the inflammatory action of gout.

Accumulation from ſecretion being deficient is extremely conducive to the production of gout. A contracted ſtate of the emunctories is, in moſt caſes, a forerunner of the diſeaſe. When the ſecretion from the kidnies, the ſurface of the body, and all other glands, is eaſy and rapid, ſuperabundant acid will be quickly evacuated from the circulation; but when there is general diſpoſition to contraction in the ſecretory veſſels, the redundancy may, by accumulation, become conſiderable, from a very gradual introduction of acid, and excrementitious matter is directed into new channels. The effects from an influx of acid have much relation to the ſtate of the emunctories, and the balance that ſhould be maintained among the organs of ſecretion. The different circumſtances of theſe under different ages, habits, and climates, will frequently account for different degrees of prediſpoſition to gravel and gout. The proper habit of gout is that, where with rigidity of fibre, and predominating dryneſs, the digeſtive faculties are imperperfect. Glandular laxity and ready ſecretion are not ſo favourable to its occurrence; but in ſuch habits concretion of the redundant acid in the urinary paſſages is not unfrequent. We may now underſtand, that not only the cauſe of the diſeaſe is hereditary, but peculiarities of habit under which that cauſe will be of moſt avail—We may be informed of the reaſons for its being leſs frequent in the beginning of life than in the decline, in women than in men, in warm climates than in cold. In reſpect, however, of habits or temperaments, it is a common and juſt remark, that they are ſo blended, and run ſo much into each other, that a diſtinction is not always eaſily made.

Van Helmont, and others, who have been of opinion that gout is connected with acidity in the veſſels, were unacquainted with the concreting acid and its precipitation. *Boſc d'Antic* and *Berthollet* have written with ingenuity upon the ſubject of animal acid. The laſt in particular has furniſhed demonſtration of the prevalence of acidity in gouty habits. But the attention of both is almoſt entirely directed to phoſporic acid. By all who have favoured the ſyſtem of acidity, the diſeaſe was ſuppoſed to proceed from the acrimony of the fluids in which acid was redundant. Such acrimony may have its peculiar effects, but would not much contribute towards the illuſtration of gout. The depoſition of lithiſiac matter from acid of another kind being redundant, is ſatisfactory in theory, and conſonant to experience. The acid that occaſions the precipitation, may ſometimes be phoſphoric acid, of which the quantity is preternaturally increaſed; but more frequently it appears to be a ſtrange acid introduced from the alimentary canal. Concerning the ſpecific acid of gravel and gout, although a conſtituent part of animal fluids, very little has been known; and in regard to its precipitation in any part of the ſyſtem, an idea had not gone forth. It is a matter, the proportion of which is minute. The quantity that may be ſeparated from half a pint of natural urine, ſcarcely appears to amount to two grains; yet, by a knowledge of its properties, it is raiſed to high importance in the animal œconomy, and two diſeaſes, of which the production has been conſidered myſterious, are clearly accounted for. It is a ſpecies of matter by which the attention of phyſiologiſts and pathologiſts will, in future, be conſiderably engaged.

When the freedom of the circulation, or the functions of a part, are interrupted by the redundant acid, the taking place of the conſequent inflammatory affection will be retarded by a condition of debility and languor, but promoted by every thing producing an increaſe of action, or by an uncommon exertion of any kind. It frequently happens, that a fit of the gout is ſuddenly brought on by unuſual repletion, by the uſe of ſtimulants, by extraordinary exerciſe, or ſome violent effort. Theſe and other circumſtances, which bring forth the latent diſpoſition, may be termed occaſional cauſes of the diſeaſe. Sudden evacuation will ſometimes have the ſame effect. It may operate by producing an alteration of action, at a time when any change will be likely to incline towards that for which the diſpoſition is moſt prevalent; or it may diminiſh the natural powers by which depoſition and its conſequent effects are reſiſted. An accidental decreaſe of force, with perhaps not unfrequently an attending increaſe of irritability, muſt be diſtinguiſhed from habitual weakneſs and chronic dulneſs of impreſſion.

Gout, in like manner as other inflammatory diſorders, is moſt apt to occur in the vernal and autumnal ſeaſons. The heart and the principal arteries, ſtimulated by the increaſe of heat in the ſpring, propel the blood with unuſual force; but the extreme veſſels, having acquired a habit of contraction, are with difficulty diſtended, ſo that reſiſtance is given, and plethora takes place. By a continuance of warm weather relaxation upon the ſurface is at laſt produced, and the plethoric ſymptoms diſappear, until external circulation is checked by the returning cold in autumn. The blood is then thrown in greater quantity upon the interior parts, ſo as to cauſe re-action, giving a tendency to inflammatory complaints. Thus the heat in ſpring, and the cold in autumn, are attended with conſequences in ſome reſpects ſimilar, and gout is moſt frequent at theſe ſeaſons. Acidity may be ſuperabundant at other times without equal riſque of that affection being produced.

The circumſtances already mentioned, as prediſpoſing the tendons and ligaments to thoſe alterations which give riſe to gout, are ſtrongeſt in the lower extremities. The feet being fartheſt removed from the center of the circulation, the force of the heart muſt be in a great meaſure ſpent before the blood can make its remote circuit through them, while the perpendicular ſituation of the body is unfavourable to its return by the veins. The fluids, therefore, in the lower extremities are often nearer to a ſtate of ſtagnation than in other parts, and there is leſs of that power by which any thing tending to produce diſeaſe is reſiſted and counteracted. For theſe very obvious reaſons, the tendons and ligaments about the toes and the metatarſal bones, are more liable to be affected with gout, than even parts of the ſame kind in other ſituations. The prediſpoſing condition of theſe parts is deſcribed with his cuſtomary energy by *Boerhaave*, who appears to have had not inaccurate ideas reſpecting the nature of gout, and only wanted for their perfection, ſome acquaintance with lithiſiac acid. "*Locus, quem primo, quem regularis aggreditur, ſemper pes; hujuſque illæ imprimis partes, quas difficillime ſuum pervadit liquidum: ut perioſtia, tendines,*

tendines, nervos, membranas, ligamenta; quæ a corde remotiores, et maxime preſſæ." His great commentator is very diſtinct and ſatisfactory on the ſame point.

It is not my intention to enter minutely into the deſcription of a paroxyſm, or into the progreſs of gout: for information reſpecting theſe, application may be made to the treatiſe of *Sydenham*, from whoſe admirable repreſentation the accounts of many ſucceeding authors have been extracted. It is ſource of infinite ſatisfaction to find, that the imputed cauſes are not only in harmony with the practical obſervations of that moſt deſcerning and experienced phyſician, but will prove adequate to the explanation of the principal phenomena of the diſeaſe. We ſhall touch upon the leading features only of this peculiar affection.

A paroxyſm of gout ſeldom makes its appearance without warning, from derangement in the digeſtive faculties, but is uſually preceded, for ſome weeks, by flatulency, want of appetite, and other ſymptoms of diſorder in the ſtomach. Theſe are not always much attended to; ſo that patients will ſometimes repel the idea of their having exiſted. In particular inſtances, as has been repeatedly ſtated, the redundancy of acid may be from cauſes independent of abſorption from the alimentary canal, and within the circulation. But in the greateſt number of caſes, nice enquiry will eaſily detect evidence of indigeſtion, during the continuance of which there has been common fermentation in the ſtomach, and a conſtant influx of acid from the *primæ viæ*. The concreting acid is detached by this foreign acid, and if, at the ſame time, there be deficiency of ſecretion, it accumulates in the fluids. The proofs of ſecretion having been defective, are not commonly obſcure. When the accumulation has got to a certain pitch, a depoſition of the particles commences, and the conſequent interruption to the functions of parts is indicated by a variety of ſymptoms, ſuch as unuſual languor, coldneſs in the extremeties, an uneaſy ſenſation frequently compared to that of pricking in the feet and legs, with numbneſs, and ſpaſmodic affections of the muſcles. Under theſe circumſtances, the gouty inflammation will ſometimes be excited by ſtimulants of any kind, by a hearty meal, or by food that requires conſiderable effort for digeſtion. When the habit is in this ſtate, a few glaſſes of wine, in which acid prevails, or any acid liquor, will almoſt immediately be felt.

The circumſtance conſtituting the diſeaſe, is an inflammation in parts of which the operations have been rendered incomplete by depoſition of lithifiac matter; and it is moſt frequently excited in the tendons and ligaments about the feet. There ariſes from it a very acute pain. The firſt attack is commonly at a very early hour in the morning, when the ſtate of external contraction, to which the animal œconomy is naturally inclined in the beginning of night, is ſubſiding, and the diſtribution of fluids towards the extremities and the ſurface of the body becomes more conſiderable. About the ſame hour other remote or external inflammations, ſuch as thoſe of ſmall-pox and meaſles, are moſt apt to take place. The pain is not ſlow in its advances, but arrives at great ſeverity in a ſhort time after it has been perceived. The increaſe of action is communicated not only to the veſſels of the ſurrounding parts, ſo as to produce ſwelling and redneſs, but to the heart itſelf, and to the whole arterial ſyſtem. By means of the univerſal exertion of the vaſcular ſyſtem, and the augmented impetus of the blood, every hindrance to natural action is, in a ſhort time, overcome, and the tendency to contraction in the various emunctories removed. The ſecretion from the ſurface of the body becomes very often profuſe; and the redundant acid, paſſing off more freely by the kidnies, appears in the urine as a lateritious ſediment. When the relaxation has continued for ſome days, the whole of the accumulated acid is diſcharged, the inflammation ſubſides, and every thing returns to its natural condition: the fit is then ſaid to be over.

When a regular paroxyſm has had its courſe, the patient is commonly left in more perfect health than he had before enjoyed. This effect has led many to conſider gout as having a peculiar property of reſtoring the vigour of the ſyſtem. That, however, was an unfair concluſion: of itſelf it cauſes a dimunition of ſtrength, but by removing every other morbid affection, it puts the ſyſtem into a diſpoſition for acquiring vigour. It proves a very univerſal remedy for numerous chronic complaints, to which the ſame deſcription of habits is ſubject. The tendency to diſorder in the ſtomach, and a multitude of ailments proceeding from it, are corrected by a paroxyſm of gout. We cannot ſufficiently admire the excellent contrivance of nature, by which many diſeaſes become the inſtruments of removing the circumſtances that produced them. The digeſtion is often perfect for ſome time after, and the ſecretions, in their natural ſtate. Diſorders, that were the ſource of permanent debility, are put at a diſtance, and the temporary weakneſs, occaſioned by the laſt diſeaſe, is ſoon recovered. But the benefit is not perpetual: after ſome time, proneneſs to acidity, with nauſea, want of appetite, and flatulency, begin to be perceived; the concreting acid accumulates again, and much inconvenience is endured, from a variety of irregular ſymptoms. Under theſe circumſtances, it has frequently been thought adviſable to employ ſtimulants for the purpoſe of exciting the inflammation, that the other complaints may be relieved by it.

The inflammation of gout has a diſpoſition to confine itſelf to the part where it has commenced; but if it be reſiſted by any circumſtance, it will, in general, be produced in ſome other ſituation. When it has been counteracted in the lower extremities, it frequently ſits down in the joints of the fingers, in the elbow, in the coats of the ſtomach and inteſtines, in the viſcera of the thorax, in the integuments of the head, in the brain, or its membranes. Theſe ſudden removals have been accounted for, by ſuppoſing that matter which has been depoſited was taken back into the circulation, and conveyed to the part next affected. But an inſtantaneous and complete tranſlation of this kind cannot readily be admitted, nor would much aſſiſtance be received from it: it is improbable and inſufficient. The nature and reaſon of changes are more eaſily explained.

In a gouty habit the depoſition of redundant acid is not confined to one part; it muſt take place in various ſituations, but in different degrees. There cannot then, for the appearance of inflammation in another part, be any neceſſity for tranſlation of a matter which is already preſent in many parts. There is an inclination to unity in local inflammations. It may be remarked of common phlegmon in particular, that it is diſpoſed to occupy but one ſituation; as if the animal powers were without the means of ſuſtaining two violent local affections at the ſame time. From this principle ariſes the practice of curing one inflammation by means of another; and ſo extenſive is it, that it frequently prevails, even when the cauſe of the original inflammation is unremoved. The diſtribution of fluids, and direction of action, which are altered by inflammation, cannot be conveyed with equal force towards two conſiderable points, but will commonly preponderate towards the one, to the deſtruction of the other. There is a diſpoſition to this kind of unity in gout, although a number of parts are under ſimilar ſuſceptibility, and the univerſal habit inclined to the diſeaſe.

It is neceſſary to be particular on this ſubject, becauſe the abſurd doctrine of tranſlation has been objected to as a part of our ſyſtem; although it is diſavowed and refuted in the laſt publication. We may conceive, that before a fit of the gout has commenced, a number of different parts have undergone, in unequal degrees, that alteration which conſtitutes ſuſceptibility of the diſeaſe. A ſtimulus is at laſt given, and the inflammation ariſes, not over the whole, but in that ſituation, where from larger depoſition, or leſs ability of relieving itſelf, the ſuſceptibility is greateſt. From this inflammation there is immediately upon the general ſyſtem, an effect which conſiſts in univerſal exertion of the vaſcular powers, and terminates in the offending matter being expelled, the circulation reſtored, and the tone of the ſtomach recovered. Such is the natural progreſs of gout; but if the inflammation be counteracted before the ſalutary conſequences have taken place, it muſt be expected that the occaſional cauſe will operate to the production of it in ſome other ſituation, to which, without any recent tranſlation of matter, a previous diſpoſition had been communicated;

—a diſpoſition not depending upon accidental tranſlation, to which phyſiology cannot accede; but upon original depoſition.

The whole ſyſtem is to be conſidered as thrown into a condition of extreme ſuſceptibility of local inflammation of a peculiar kind, from a particular cauſe. If the ſtimulus to increaſed action is not permitted to expend itſelf upon the right foot, the diatheſis of gout remains unabated, and may naturally fall upon the left. If it be driven from that likewiſe, it may occupy the wriſt, or the elbow, or any other ſpot where the ſpecific ſuſceptibility is preſent. Here is not a tranſlation of matter, but of the action, which, like many other violent actions, has an inclination to unity, although the parts prediſpoſed to it may be numerous.

During a regular paroxyſm, the lithiſiac matter that has been depoſited is probably taken back to the circulation, that it may be carried off by the emunctories. If, after a portion of it has been abſorbed, any interruption is given to the neceſſary relaxation of the organs of ſecretion, there may be an increaſe from it of depoſition in other parts; but a ſudden and entire tranſlation of matter from one ſpot to another, is incompatible with reaſon, and would not lend any aſſiſtance in explaining the tranſitions that take place. It is as unneceſſary as it is difficult of comprehenſion. In rheumatiſm, removals of the inflammatory affection are nearly as frequent, and the diſeaſe reſiſted in one part, very often occurs in ſome other, to which a preceding diſpoſition to ſuch affection had been communicated. A tranſlation of matter has not then been ſuſpected: in this caſe, as in gout, there is a tendency to unity in the inflammation when violent, although the pre-diſpoſing alteration may not be confined to one part. This is not the only circumſtance of analogy between theſe diſorders: an impediment to the circulation, and proper functions of the parts affected, is the proximate cauſe of each; but the alterations producing that impediment are different. The interruption in rheumatiſm ariſes from the diminiſhed ſize of the veſſels themſelves, and a contracted condition of fibre—in gout it proceeds from the preſence of an uncommon matter. The parts affected in the firſt are as obviouſly the moving powers, as that organs of indolence and inaction are moſt expoſed to the ſecond. The alteration, however, has in both the effect of occaſioning particular exertions of the ſolid matter of the body, with increaſed velocity and force of the fluids, for the purpoſe of correcting the error that has taken place. Frequently they are blended from the cauſes being conjoined in the ſame habit, and it becomes difficult to pronounce upon the identity of either. Such caſes are of the moſt obſtinate kind, as the courſe of each is interrupted by the other, and the progreſs of both rendered irregular and unbeneficial.

When the inflammation of gout has ariſen in one foot, and is ſo acute as to produce, in a proper degree, that ſymptomatic affection of the ſyſtem, or general increaſe of vaſcular exertion, which may be called the fever of gout, the relief from depoſited matter is extended over the body, and inflammation of other parts is avoided. Frequently, however, the depoſition in different ſituations, has been ſo conſiderable, as to require actual inflamation in them likewiſe, and ſtill the inclination to unity prevails. The part next attacked, which in regular gout is commonly the other foot, does not become affected till the firſt inflammation has nearly ſubſided. By a ſucceſſion of ſuch affections the diſeaſe may be continued for a length of time, and its criſis ſhall become very incomplete. This is not often the caſe in habits of tolerable vigour, when the natural progreſs has not met with artificial interruption. The inflammation in the feet would generally be fully adequate to the relief of the whole ſyſtem, and the paroxyſm would be concluded within a fortnight, if fair ſcope were given to the diſeaſe. The period of gout would ſeldom be of longer duration, if every counteraction to the natural exertions, local and general, was avoided, and the ſtomach put under ſuch reſtraint and regulation as ſhould not interfere with the expected return of the proper faculties of digeſtion. The reſtriction of a few days would ſave from many weeks of anxious confinement, and painful infirmity. But when patients are with difficulty induced to deviate from their common courſe, and refuſe to yield to the unambiguous warnings of the diſeaſe—when they are only reſtrained from motion by intolerance of pain, and are impatient to return to their cuſtomary habits as ſoon as the agony is leſs acute—when they diſdain the means that would contribute to the requiſite relaxation of the emunctories, and ſhrink not from expoſure to circumſtances by which external contraction is promoted—when they are unwilling to leave the ſtomach, for a few days, to that ſtate of quiet which is of the greateſt importance for the reſtoration of its tone, but continue, in defiance of concomitant flatulency and unabated diſorder, to gratify their appetites — When theſe and other complicated errors are committed, it cannot be ground of aſtoniſhment, that paroxyſms are frequently prolonged to an extraordinary period, and that relapſes ſhould come in quick ſucceſſion. Under ſuch circumſtances the ultimate intention of a paroxyſm is never obtained, and parts, by reiterated renewals of the ſame mode of action, may even acquire a habit of falling into it when the original cauſe is removed. A tendon, that has ſuffered extremely from an almoſt unremitting affection, may become liable on other occaſions to inflammation that ſhall have reſemblance to gout.

From the hiſtory that has been given, the danger of counteracting a paroxyſm, or checking the inflammation of regular gout, becomes conſpicuous. Local remedies, by which the affection is likely to be removed from one part to uncertain ſituations, where it may be attended with greater inconvenience and riſque, have long been condemned by judicious practice. If by any ſedative application, or a contiguous bliſter, the recent affection of the foot is carried off, the ſyſtem will generally remain without the relief to other parts that would have been produced by a paroxyſm, and the inflammation muſt ariſe in ſome new ſituation. General evacuations for the purpoſe of diminiſhing the fever, which is a neceſſary part of the diſeaſe, as the inſtrument of relief to the ſyſtem, cannot with propriety be carried to great extent. Coſtiveneſs, indeed, is always to be prevented; and there are caſes when the ſymptomatic exertion is ſo violent as to threaten injury to the brain, or other vital parts, and may require to be moderated. Such caſes, however, ſeldom occur when due attention has been paid to neceſſary management, and too much application has not been made to hot and ſtimulating articles, under pretence of keeping the diſeaſe from the ſtomach. Articles of that deſcription are generally injurious; but by cautious regulation of food, and prudent adminiſtration of proper medicines, much may be done towards aiding the efforts of nature, in carrying a paroxyſm through its progreſs with the beſt advantage to the body, and in reſtoring the tone of the ſtomach.

When gout ſits down in a part where it cannot continue without danger, or by accident has been tranſlated to a part of that kind, means become neceſſary of moderating its violence, and of endeavouring to fix it in ſome other part of leſs general importance. In ſuch caſes an attempt to evade a paroxyſm and correct the diſpoſition, by obviating acidity and accumulation, the circumſtances upon which it chiefly de-

depends, may ſometimes become adviſeable. To perſons acquainted with the animal œconomy, and the particular nature of this diſeaſe, the methods of anſwering theſe intentions will not be difficult of comprehenſion. The ſymptoms of gout may be brought almoſt entirely under medical guidance, ſo as to be regulated to the mode and termination that is deſired.

In gout, the inflammation is commonly moſt accute when within narrow compaſs, and when very accute, its term of duration is ſhorteſt, and its operation upon the ſyſtem moſt complete. When it ſubſiſts in ſome degree, in many ſituations, the ſymptoms are leſs violent, but the progreſs more tedious, and the concluſion leſs ſatisfactory. For the perfection of a regular paroxyſm, a certain degree of power in the ſyſtem is requiſite. In conſtitutions very much debilitated, the affection is not confined to the feet, but appears in other parts of the body, and hangs about the patient, producing chronic weakneſs: the diſorder in the ſtomach continues without much alleviation, the redundancy of acid remains undiminiſhed, and the functions of the whole ſyſtem are impaired. The tendons and ligaments do not recover their former flexibility, as when the general habit has been relieved by a regular paroxyſm, but depoſition

poſition goes on till they are rendered rigid and incapable of motion: or, the concreting matter accumulating on their ſurfaces, with a mixture perhaps of the mucilaginous matter of the blood, produces calculi, in which the aggregation of particles is leſs firm than from more perfect chryſtallization in the bladder. The condition of the unhappy patient is now truly deplorable; as the ſtate of reſt, to which he is condemned, conduces likewiſe to concretion of the redundant acid in the urinary paſſages. Nephritic affection becomes more than uſually troubleſome, and he has difficulty in determining, whether his ſufferings are greateſt from gravel or from gout. Such is the melancholy termination to which this diſeaſe, without circumſpect management, is perpetually inclining, as by great frequency or protraction of the fits, a ſtate of debility is at laſt brought on in habits originally moſt rebuſt.

Gout is a diſeaſe proceeding from a redundancy of acid in the ſyſtem, and that redundancy is connected with the introduction of foreign acids, or the generation of acid in the alimentary canal. It does not follow, however, that acids, employed with much freedom, or produced in the ſtomach by frequent fermentation, ſhould occaſion gout in every inſtance:

the effect will have relation to the natural proportion of lithiſiac matter, to the condition of the emunctories, to particular ſtates of habit that may favour or reſiſt depoſition and its conſequences, and to pre-diſpoſitions to other diſeaſes which may prevail over that of gout. The redundancy of acid may ſometimes be expended in promoting ſpecific morbid affections of a different kind, to which the conſtitution is inclined. But there remains to be conſidered a faculty within the animal œconomy of counteracting acidity, and of obviating or diminiſhing the injury that might ariſe from it. This is a property appertaining to the fluid which makes the ſubject of the following ſection.

SECTION V.

On the Bile, and its Concretions.

BESIDES the concretions to which the body is liable from lithiſiac acid, which may be depoſited in any part, there is another kind peculiar to the liver, and produced from the fluid ſecreted by that gland. Biliary calculi are formed of a matter very different in its nature, yet, in the means of production, there are circumſtances of analogy which require to be noticed, and conſtitute ſuch connection as properly unites the ſubjects into one. The qualities of the bile, and the alterations to which it has been ſuppoſed liable, have always attracted much attention. The ſize of the liver, its ſituation in the body, the quantity of blood with which it is ſupplied, and a very ſingular deviation in its vaſcular arrangement from the general order of the ſyſtem, have impreſſed conviction of its importance, in the mind of every perſon who has reflected upon it. Its condition, or that of the bile, of which the ſecretion is its particular function, have in general been ſuſpected to have conſiderable influence upon the body in health and in diſeaſe; yet not only the peculiar purpoſes of the hepatic fluid are undetermined, but its nature and compoſition have till very lately been perfectly unaſcertained. They are at this moment unknown to many, although it will be found that acquaintance with them is of the greateſt conſequence to practice in diſeaſes of the firſt magnitude, and that the errors, from want of information on the ſubject, have neither been trivial or uncommon.

A multitude of conjectures have been formed reſpecting the bile, but they were unſupported by experiment. It has often been termed ſaponaceous, from a reſemblance it has to ſolutions of ſoap in conſiſtence, in taſte, and in purpoſes to which it is applicable. The taſte is ſtrongly marked; for, in the confuſion of varied impreſſions upon the tongue, there is not one more eaſily diſtinguiſhed than that of ſoap. A man who had never known any thing of bile, if deſired to form a judgment concerning it from the taſte merely, would not heſitate in pronouncing it ſaponaceous. Natural bile has a viſcidity like that of ſolutions of ſoap. It may in like manner be diluted by the addition of water, or inſpiſſated by evaporation, without being altered in its properties. For many purpoſes to which ſoaps are applied, the bile of animals has been ſubſtituted with ſucceſs. Saponaceous, however, was a denomination employed, from regard to theſe and other obvious qualities, without much reſpect to the conſtituent matters of an actual ſoap. It was rejected by very diſtinguiſhed chemiſts, becauſe the exiſtence of an alkaline element had not been demonſtrated. They refuſed to admit it into a claſs, which the juſt preciſion of chemical language had confined to the compounds of an alkali with another matter. Newmann, than whom few have been more correct, is of the number, although he had obtained a fixed alkali from bile by means of fire. This product he regarded not as a native element, but, like many products by heat, as a new body reſulting from decompoſition and different arrangement of elementary ingredients.

The connection of bile with the operations of the ſtomach, and conſequently with that ſtate of the ſyſtem in which acidity is ſuperabundant, induced me to examine it with ſome degree of care. Attention to ſtriking qualities, and to the alkali of Newmann, inclined me to conſider it as a ſoap. This opinion was ſtrengthened by the effects of acids which cauſe a decompoſition,

poſition, and are in part deſtroyed. After a ſeries of experiments, I had the ſatisfaction of being ſatisfied that it is a perfect ſoap, conſiſting of fixed alkali and a particular ſubſtance which has been termed the reſin of the bile. I was at that time a ſtranger to the diſcovery having been already made by a *Monſ. Cadet*, a French chemiſt. I am ſtill ignorant of the proceſs he purſued, having only become acquainted with his publication from a ſhort reference to it in another work, the new edition of *Encyclopædia Britannica*. On this account I ſhall relate the manner in which my own inveſtigation was ſucceſsfully conducted.

Every body is acquainted with the appearance of recent bile. The colour is green inclining to yellow; the taſte ſaponaceous and intenſely bitter. Differences of no great moment may ſubſiſt in colour, flavour, and conſiſtence of the bile of different animals, or of the ſame animal at different times, but eſſential properties appear to be nearly the ſame. It cannot often be obtained in perfection from the human gall bladder, alterations having uſually taken place before diſſection is permitted. The bile of the ox is to be preferred for experiments, on account of the facility with which it may be procured untainted, and in ſufficient quantity.

When an acid is mixed with recent bile, there takes place an evident decompoſition. The whole, from having been tranſparent, is immediately rendered turbid, the ſaponaceous viſcidity is deſtroyed, and a ſolid matter, which in ſome reſpects is different in appearance when different acids are employed, but generally appears of a ſhade between green and yellow, deſcends to the bottom. A ſmall portion of the acid is neutralized, as has already been obſerved, and if more than that quantity be not uſed, the mixture does not betray any marks of redundant acid. During the decompoſition a fœtid hepatic vapour ariſes. Theſe effects from the application of acids, conjoined with the other circumſtances of reſemblance to ſoaps, could ſcarcely leave a doubt in reſpect to the nature of bile. The concluſion is natural, that it muſt be a ſaponaceous compound, in which an alkali is united with the ſubſtance that may be precipitated. Nothing, however, in chemical claſſification ſhould reſt upon preſumption, when poſitive evidence can be obtained. It was neceſſary that the alkali ſhould be abſtracted from the other parts, and that its exiſtence ſhould be demonſtrated by a proceſs during which it could not be ſuſpected to have been generated. I reſolved upon endeavouring to exhibit it, by chryſtallization of the neutral ſalt it would form with an acid.

Into a pint and a half of freſh bile procured from the gall bladders of two oxen, four drachms of muriatic acid of the common ſtrength were agitated. Acidity predominated in the mixture, but was not nearly ſo pungent to the taſte, as if an equal quantity of the ſame acrimonious acid had been added to a common mucilaginous fluid. After an hour or two, when the precipitation appeared to be complete, the ſolid matter was ſeparated by means of a ſtrainer of fine linen. The fluid that paſſed through, was made to boil in an earthen pipkin placed over a ſlow fire, till ſcarcely ſix ounces were remaining. During the evaporation, a portion of matter, of the ſame nature as that which had been collected in the ſtrainer, was depoſited. This is the matter which has been called the reſin of the bile. It melts in the fire; when dry it becomes inflammable; and, like reſinous ſubſtances, it is readily ſoluble in alkohol. It is that part of the bile, from which the colour and flavour are derived. It is not however ſo inſoluble in water as the denomination of reſin would intimate. A conſiderable quantity of it remains ſuſpended in the aqueous fluid, ſo as even to paſs with it through the pores of a filtering paper, and to occaſion the difficulties that occur in analyſing mucilaginous fluids. Of that which had been ſo retained, a portion gradually ſubſided as the water was waſted by evaporation. When the fluid was reduced to ſix ounces, the depoſite looked at the bottom like a melted reſin perfectly tranſparent, and of a very beautiful green colour, which might perhaps engage the painter's attention. Its quantity was ſo conſiderable, that there was neceſſity for the liquor being decanted from it. The evaporation was continued in a ſmaller pipkin, and when the diminiſhed quantity did not exceed two ounces, it was permitted to become cold. The taſte, independent of the bitter communicated by the reſinous matter, was like that of water with a large proportion of common ſalt diſſolved in it, and a little ſuperabundant acid. The ſolution, however, was not yet ſufficiently concentrated for chryſtallization. The fluid was poured off from a ſecond depoſite of reſin, by which the operation would have been obſtructed and the iſſue rendered obſcure, into a little earthen pot, and a ſlight application of heat was made until the whole was reduced to between three and four drachms. The point of concentration had now arrived, and a chryſtalline matter began to appear upon the ſurface.

The chryſtals, ſeparated from the inconſiderable portion of fluid that remained, were waſhed with alkohol for the purpoſe of clearing them from ſome adhering particles of the reſinous matter by which they were rendered of a brown colour; for reſin, but not of equal beauty, had continued to be depoſited to the end, and appeared manifeſtly to be a ſubſtance of which a portion is ſoluble in water from which it is made to ſubſide by evaporation. They had now the marks of common ſalt, and, chemically examined, were diſcovered to be pure ſalt, conſiſting of muriatic acid with ſoda, or natron, improperly termed the foſſile alkali. The muriatic acid was made evident in fumes by the addition of vitriolic acid, and by the precipitation of *luna cornea* from the ſolution of ſilver in nitrous acid. The nature of the alkali was demonſtrated by examination of the ſalt it formed with vitriolic acid. This compound was vitriolated natron, or true Glauber's ſalt, whoſe property of combining into particular chryſtals, with a very large quantity of water which may be again ſeparated from it by heat, affords a ready means of diſtinction.

It was now evident that the bile is a perfect ſoap, in which the alkali of ſea-ſalt is in conjunction with the reſin, and that the alkali which

Newmann obtained was not generated in the fire by a new modification of the elementary principles of this fluid, but was itſelf a native element upon which the moſt eſſential properties depend. If that alkali had been the produce of fire, it might have been obtained from the reſin alone; but a quantity of waſhed reſin did not by calcination yield a particle. I procured the alkali by burning inſpiſſated bile, and found it to be the natron. For demonſtrating it in this manner, it is not neceſſary that the heat ſhould be of that degree which would be ſuppoſed requiſite for the generation of an alkali—the matter need not be conſumed to aſhes. After a certain expoſure, the ſolid maſs becomes incapable of re-combining with water into a fluid ſoap, and the alkaline portion may be waſhed out from the reſin, which, in approaching towards the ſtate of a cynder, has been rendered incapable of continuing in conjunction with the natron. Newmann, knowing that a fixed alkali can ſeldom be obtained by the decompoſition of animal matter, has expreſſed his aſtoniſhment at meeting with it in the aſhes of the bile; yet, regarding it as a new product, he has contended againſt that fluid being conſidered an animal ſoap. It may be thought ſtrange that he ſhould not have been at pains to aſcertain the ſource of a ſubſtance ſo rare and unexpected; but in the multitude of objects coming under the obſervation of a man, who endeavours to make out a ſyſtem of any ſcience ſo extenſive and complicated as that which treats of the compoſition and properties of the various modifications of matter upon this globe, every particular phenomenon cannot meet with the attention requiſite for a perfect explanation of it. It is probable that fixed alkaiis from vegetable ſubſtances might generally, like that of the bile, be diſcovered as elementary principles of the articles from which they are obtained, and that heat has only the effect of deſtroying ſome different matter with which they were combined. The juice of *ſaponaria* and ſome other vegetables are ſo manifeſtly ſaponaceous, that neutral ſalts might be expected from them by the addition of acids, and careful evaporation.

The chryſtals of common ſalt, which were firſt collected, appeared free from any mixture of earthy ſalts. A ſolution of them in water was not rendered turbid by alkalis. The liquor, however, remaining in the gallipot after they had been picked out, contained not only muriated natron, but a minute portion of the other ſaline ſubſtances which are common to the fluids. There was evidently lime ſuſpended by an acid, or phoſphorated lime kept in ſolution by ſuperabundant acid. An earth of this kind may always be precipitated from pure bile by volatile alkali. There was probably muriatic ammoniac, and phoſphoric acid in a ſeparate ſtate. If the alkali collected from the aſhes of the bile be ſaturated with muriatic acid, and the compound ſalt expoſed to a very conſiderable degree of heat, it will not readily become dry, but there will continue adhering to it a fluid matter, acid to the taſte, and very difficult of evaporation. This moiſture may be waſhed off by alkohol, and ſubmitted to experiment. It is phoſphoric acid detached by the muriatic acid from volatile alkali, with which it had formed a neutral compound that mingled after combuſtion with the fixed alkali, and was taken up along with it by the water employed for elixation.

The proportion of other ſaline ſubſtances is inconſiderable, compared to that of the alkali in conjunction with reſin merely. From a pint carefully burnt to aſhes, I got as much natron as formed with muriatic acid a drachm of ſea-ſalt. The quantity of reſin in bile, in like manner as of oil in common ſoap, is much greater than that of alkali. The bile in different gall-bladders will be found of different degrees of viſcidity. The reſpective proportions of alkali and reſin may probably differ, and the rate of the compound of the two to that of the water in which it is diſſolved, is undoubtedly various. The ſolution is of different degrees of concentration, and, independent of the ſaponaceous principle, there muſt be in this as in other fluids of the body, a portion of animal gelatinous matter, to which may be owing the putreſcency of the bile. The ſimple reſin appears ſcarcely ſuſceptible of the putrefactive fermentation, but might rather come within the claſs of anti-fermentatives.

The attraction of the alkali to the reſin of the bile is greater than to oils or mucilages in general. Decompoſition does not appear to be occaſioned by carbonic or lithiſiac acids, or by the neutral compounds of lime and magneſia with acids; but it enſues from the addition of metallic ſalts. The degrees of affinity, however, with relation to other bodies, have not been much inveſtigated. To eſtabliſh its ſaponaceous property was the principal object of our inquiry, as the alkali becomes of importance in conſidering the operations of the ſtomach, and the different effects upon the ſyſtem from an acid introduced or generated. A knowledge of the nature of the bile makes us acquainted with an original and inherent means of counteracting acidity, and the connection which will be found between the liver and the ſtomach affords another teſtimony of nature's many exquiſite principles, by which faculties are exerted in proportion to exiſting neceſſity. An increaſed ſecretion of this fluid is a frequent conſequence of that derangement which gives occaſion to the production of acid.

I would not ſuppoſe that the correction of acidity in the alimentary canal is the chief intention of the bile, as there are many animals purely carniverous, in whoſe ſtomachs there cannot be any fermentation of the acetous kind. To guard againſt the prevalence of acid may be a collateral uſe of it; but this extraordinary ſecretion is probably more eſpecially deſigned for maintaining paſſage through the inteſtines; a purpoſe which cannot be conſidered of little importance, and of almoſt equal neceſſity in moſt animals. When we reflect upon the great length of the canal, its narrowneſs in particular parts, and cellular conformation in others; the redundancy of its inner membrane, and the villous nature of its ſurface; the contortions and convolutions, which as often require the contents to be carried forward in oppoſition to gravity as with the aid of it, we ſhall ſee the neceſſity for ſome lubricating fluid capable of mingling uniformly with the various matters that paſs along, ſo as to give harmony and greater ſolubility to the whole, that the particles may be prevented from adhering and accumulating. Such a fluid is the bile, which, with the properties of a ſoap, combines into one ſmooth and uniform mixture the different kinds of matter with which it becomes blended, and, by rendering the ſurface eaſy and glibe, forwards their deſcent and expulſion. Mucus alone, not mingling readily with other fluids, would have been unequal to the taſk. There was required a ſomething of certain viſcidity, yet univerſally inſinuating and diffuſible, which ſhould become the connecting medium of heterogeneous particles by that particular degree of attraction which ſhould allow them to ſlide eaſily upon each other, while the contents of the inteſtine were retained by it in a fit conſiſtence for being propelled. There was neceſſary a ſlippery attenuating matter that ſhould defend the gut, and, by facility of conjunction with other fluids, effectually ſecure againſt coheſions, unnatural collections, and painful interruptions to periſtaltic motion in a canal of ſuch extent.

Such are the purpoſes which have been frequently aſcribed to bile, when there was leſs certainty about its actual compoſition. Van Swieten in many places expreſſes himſelf concerning it with clearneſs and preciſion. *Hujus admiſtia nimiam ſæpe chyli aceſcentiam tollit, omnia dîvîdit, ſolvit, et ad æquabiliſſimam miſcelam diſponet.* The ſame elaborate and comprehenſive commentator ſpeaks in a very poſitive manner of the ſaponaceous quality of the bile, without having had the advantage of knowing its alkaline principle from demonſtration. *Bilis verum ſaponem nativum in animali corpore exhibet. Crudis ingeſtis, per ventriculi actionem jam parum ſubactis, in homine ſtatim bilis affunditur, ut æquabiliſſima fiat omnium miſcela, et ſolubilitas in aquoſis. Sericeas veſtes pinguibus maculatas, bile animalium pulchre depurare noverunt artifices.* In different parts of his works he has made valuable remarks, and excellent obſervations reſpecting this fluid, and changes that occur in it. So much has been written concerning the bile, and its purpoſes, qualities, and alterations have been ſo happily imagined by writers of great account, that the ſubject does not afford much ground for novelty. The deſign of this diſſertation is not to ſtart new opinions, or conſtruct new theories reſpecting it, but to enforce old ideas, which, wanting the confirmation of experiment, have frequently been ſuppoſed to be viſionary. I have little to advance that might not be ſupported by reſpectable quotation; yet it muſt be remarked, that ſentiments which accord beſt with its real qualities, were generally disfigured or obſcured by the ſurrounding preſſure of hypothetical fiction, and have appeared lately to be almoſt abandoned. In recent works of men of great celebrity—even medical teachers of no mean repute—there is not diſplayed any acquaintance with the nature or uſes of this fluid. The ſame deſire of correctneſs which actuated Newmann, has induced them to reject it from the claſs of ſoaps, and its condition and application are left entirely unſettled. It may be of ſome importance to detach from vague conjecture, the moſt rational opinions concerning it, and to place beyond diſpute the knowledge of its compoſition and properties, that it may not in future be thought a matter *ſui generis*, and diſtinct from every other ſpecies.

The effects which are obſerved from a want of bile in the inteſtines, afford evidence of its utility in maintaining the paſſage. The fœces when evacuated have generally a broken appearance, as if the diſſimilar matters that compoſe them were ill conjoined. The ſurface ſeems as if a part had been rubbed off and left adhering to the inteſtines. There is not uncommonly irritation, and very frequent calls, yet the lubricating and harmonizing medium being abſent, accumulation inevitably takes place, and what is retained gets into a ſtate of unnatural ſolidity and coheſion, which is incompatible with the proper interpoſition of a ſaponaceous fluid. In caſes of this kind, the moſt uſeful remedies are ſuch as bring bile into the canal, or, by reſemblance in properties, become ſubſtitutes for it while it is withheld.

Let it not be ſuppoſed that to aſſign to the bile the purpoſe of keeping clear the inner ſurface of the inteſtines, is under-rating the conſequence of the liver. There is ſcarcely another function of greater magnitude in the œconomy: it is a principal office of this fluid, but perhaps not the only one. The bitter reſin may ſtimulate the canal to that requiſite action, by which the proceſs of digeſtion is continued, and the common fermentations reſiſted, after the aliment has paſſed from the ſtomach. When in jaundice there is perfect obſtruction to the entrance of the bile into the gut, putrefaction or acidity, according to the nature of the aliment, is conſtantly occurring in the *primæ viæ*, and the digeſtive proceſs becomes very incomplete. It is worthy of remark, that the bitter of the bile has conſiderable reſemblance to that of vegetables, which is known to be a check upon fermentation. It may tend to guard in the inteſtine againſt proceſſes, to which the warmth and moiſture of the ſituation would greatly pre-diſpoſe; and, while it renders the ſubſtances in the canal leſs ſuſceptible of theſe changes that ſpontaneouſly occur in dead matter, it may ſtimulate to more ſucceſsful exertion the native powers of aſſimulation, by which acidity and putrefaction are counteracted. The advantage in ſuch caſes, when inflammation is not the cauſe, of alkalis in conjunction with bitters and ſtimulating anti-fermentatives ſuch as myrrh and camphor, over that from ſimple ſoap, gives preſumption of the natural effect from the reſin of the bile.

The bile has been much called into action by medical enquirers, as an agent in diſeaſe. Like other ſecreted fluids it muſt be liable to morbid alteration, and its importance in the alimentary canal, where its condition is blended with that of the digeſtive faculties, and with the proper action of the inteſtines, will render the evil extended. It muſt be obſerved, however, that many ſuppoſed ſtates of it have reſted merely on conjecture, and that real alterations in quantity or quality are as often the conſequences as the cauſes of diſeaſes that have been attributed to them. Attention to the circumſtances of particular caſes, may furniſh conſiderable information in reſpect to the condition of the bile, but the only change which can be treated of in certain and decided terms, is that in which concretions are produced from it. It is an alteration very frequently occurring and from which heavy ſufferings are endured.

The calculi formed in the liver and gall-bladder differ entirely from thoſe of the urinary paſſages, and appear to conſiſt principally of the reſin of the bile. They are commonly ſoluble in alkalis and in alkahol. They melt in the fire, and are inflammable. In general properties they agree with the matter that is precipitated from bile by acids: a queſtion then ariſes, whether or not the ſeparation even in the body may not be effected by an acid? It is certain that habits, in which they commonly occur, are thoſe in which acid is redundant. The formation of gall-ſtones is generally accompanied with great derangement in the functions of the ſtomach. The ſymptoms, which paſs under the denomination of bilious, and proceed from vitiated digeſtion, are ſeldom wanting. Cloſe obſervance of the circumſtances under which they are generated, affords the ſtrongeſt preſumption of the influence of acids, received into the ſtomach, or formed in the body by a morbid proceſs of fermentation, in producing them. It may be aſſerted, without much riſque of contradiction, that gall ſtones are ſeldom preſent when acidity in the firſt paſſages has not abounded. This being the caſe, and the alteration correſponding exactly with the effects of acids upon the bile, we are induced to ſuppoſe that the acid of the ſtomach is conveyed to the liver.

By ſome who had obſerved what was called the coagulation of bile by acids, it has been ſuppoſed, that acid from the duodenum might aſcend through the ductus communis by a retrograde motion into the liver and gall-bladder. This, however, cannot be admitted by any perſon who has conſidered the natural ſtate of that duct, and its mode of entering the gut by running between the membranes ſo as to have its orifice ſecured. It ſometimes indeed becomes unnaturally diſtended by the paſſage of gall ſtones; but theſe have been formed while the vaſcular contrivance was unimpaired. The aſcent of acid by the common duct is properly rejected by Dr. Leake in his Treatiſe on Diſeaſes of the Viſcera, and gall ſtones are regarded as inſpiſſated bile from evaporation. But this opinion is equally defective. Bilious concretions are not the whole matter of bile, ſuch as it obtained when the water is abſtracted. They are not a ſolid reſiduum capable of recombining with water into fluid ſoap. The alkaline principle, which ſimple evaporation would preſerve, enters not into their compoſition. It is utterly impoſſible that evaporation ſhould take place in a receptacle like the gall-bladder, excluded from every communication with common air, and perpetually kept full by an inherent power of contracting to its contents. If their qualities had accorded with thoſe of bile which had only been deprived of its water, we might ſuppoſe that, during its continuance in obſtructed ducts, or in the gall-bladder, the aqueous fluid had been abſorbed; but they are devoid of an eſſential element, which cannot be withdrawn by evaporation or abſorption.

That acid may be taken up by the lacteals, and carried unaltered to the hepatic ducts in the common circuit of the blood veſſels, does not appear impoſſible. A very gradual but habitual impregnation from this cauſe might produce concretion in the end. Huxham, who as a practical author is regarded with juſt reverence,

verence, to which his diſcrimination and diſcernment are well entitled, had full conviction of the effects of predominating acidity on the bile, which with ſhrewd obſervation he conſidered as a ſaponaceous fluid. Upon the univerſal tendency of acids in the ſyſtem, as well as upon their local effects in the inteſtine, where they decompoſe a matter which is of the utmoſt importance to the functions of the alimentary canal, he has made ingenious remarks, to which he would have derived grateful confirmation from an acquaintance with lithiſiac acid, and with the aſcertained compoſition of the ſecretion that is made in the liver. When acidity ſuperabounds in the general fluids, the bile muſt be expoſed to its effects; but the vena portarum, if it could be reſtored to the faculty of abſorption, which it was formerly allowed to poſſeſs, would ſupply a readier channel from the ſtomach to the liver, and every difficulty would ceaſe. An attempt to revive a doctrine ſo much exploded, as the abſorbing power of this vein, may not perhaps meet with a flattering reception; but regard to probability, and reſpect to the impreſſion from a candid eſtimate of the arguments on both ſides, prevail over the apprehenſion of ridicule from ſuſtaining an opinion that has become obſolete.

Let us take a view of the objections that have been oppoſed to it as an obſorbent.

The peculiarities of the vena portarum in ſending its blood, not directly towards the heart like other veins, but into the liver, where it divides into innumerable ramifications after the manner of an artery, have much ingroſſed the notice of anatomiſts and phyſiologiſts. That this deviation from the eſtabliſhed order of veins is intended for conveying from the alimentary canal ſomething neceſſary for the ſecretion of the bile, was a plauſible concluſion. When an order of veſſels however, the proper abſorbents, had been traced over the body, and their duty clearly aſcertained, it was contended, that to aſcribe to the vena portarum a faculty of abſorbing from the ſtomach and inteſtines, would be to infringe upon the office of a peculiar and diſtinct ſyſtem provided for the particular purpoſe and ſole end of abſorption. The ſuppoſition was ſaid to be contradicted by the eſtabliſhed order of the œconomy, to every part of which its ſpecific purpoſe is allotted. To analogical reaſoning was added evidence from experiments on living animals. Odorous and coloured fluids thrown into the inteſtines of a dog, whoſe abdomen had been laid open, were ſoon perceived in the lacteals, but could

not

not be traced into the veins that ariſe upon the gut. Such were the grounds upon which an abſorbing property was denied to the meſenteric veins which form the vena portarum; but although the excluſion has been ſuſtained by the greateſt phyſiologiſt of the preſent age, whoſe aſtoniſhing genius and exquiſite penetration, directed with indefatigable induſtry towards the ſtudy of animal nature, will engage the admiration and gratitude of ſucceeding generations, the authority even of Mr. Hunter does not in this inſtance produce conviction.

The argument from analogy is plauſible to the firſt view, but fades before reflection. The conſtitution of the vein in reſpect to another function renders it of little weight. Its blended offices as an artery and vein form not a leſs conſiderable infringement upon the diſtinctneſs of ſyſtem in the body, than the ſuppoſition of its being an abſorbent: the vein is in itſelf a ſingular exception from the general order of the vaſcular œconomy. By carrying blood for the purpoſe of ſecretion to the liver, it breaks in upon arterial privileges, and may, in like manner, be conceived to preſs upon the abſorbents, by being veſted with properties which are peculiar to the lymphatics in other parts of the body. That it may be the inſtrument of conveying from the inteſtines ſomething neceſſary for the formation of bile, is indeed the only probable reaſon that can be aſſigned for its being made to aſſume the functions of an artery. If the blood alone had been ſufficient for the compoſition of that ſingular fluid, we may imagine that the liver would, like other glands, have been ſupplied by the arterial ſyſtem. The greateſt deviation from the ſimplicity of ſyſtem, is its indiſputable duty as an artery. This eſſential exception to the common order, is probably intended as a means of maintaining a neceſſary intercourſe between the alimentary canal and the liver, that the bile may be adapted to circumſtances, and produced under ſuch modifications, as particular ſtates of that canal may require.

Analogical deduction appears entirely in favour of the abſorbing power, and the experiments on living animals will not afford any ſolid grounds of concluſion on the other ſide. That they were made with every degree of accuracy, which the nature of them would admit, is not to be doubted: but it ſeems impoſſible to eſtabliſh any form of experiment which would give perfect ſatisfaction. That the lacteals are abſorbents is univerſally acknowledged, and the fluid with which they became turbid, could be that alone which was taken up from the inteſtine: it would appear pure and without dilution, ſo as to be readily recognized. But very different is the caſe with reſpect to the meſenteric veins, which ariſe from the viſcera, and unite to form the vena portarum. If circulation by the meſenteric artery be permitted, any fluid abſorbed will bear too minute a proportion to the torrent of blood to be detected in conjunction with it. If the arterial impulſe be ſuſpended, there muſt be an end to every function of the vein, which will immediately ſubſide into a condition of flaccidity and inaction. It is not ſtretching an argument, to ſuppoſe that the ſtimulus of diſtention by blood, propelled by the heart and flowing from the artery, may be a requiſite for the abſorbing function. Abſorption may take place by the particles of that blood moving with rapidity in the villous ſurface, and attracting, by communication through the fineſt capillaries, a portion of ſuch fluids as are in the canal. A ſimilar communication is made in the lungs, between blood and the air of reſpiration. It is obvious that experimental conviction cannot be obtained: we muſt be ſatisfied with preſumptive evidence, and the ſtrongeſt is in favour of abſorption by veins from the ſtomach and inteſtines. Attention to circumſtances in diſeaſe, and to alterations from food and medicine, will corroborate the opinion.

It might be expected, that if the meſenteric veins be endowed with an abſorbing power, the liver will often be liable to be affected by improper matter taken up from the ſtomach and inteſtines. Error in diet, and defect or diſorder in the digeſtive proceſs, will expoſe it to the unſalutary influence of fluids foreign to its purpoſe. Such would be the ſuſpicion *a priori*, and ſuch is the fact not only in the human ſpecies, but in the brute creation. It may be collected from the accounts of the moſt faithful writers, that the greateſt number of liver complaints have ſucceeded to derangement in the alimentary canal. The diſeaſes of that viſcus may be almoſt conſidered as ſymptomatic of ſtomach affection. In other animals as well as in man, it is accuſtomed to ſuffer from noxious matter conveyed by the vena portarum. This is a fact to which the butcher could bear teſtimony. Change of paſture, or the employment of any kind of food which the ſtomach does not readily aſſimulate, is marked by injury to the liver; and the diſpoſition to diſeaſe in any particular claſs, is in proportion to the error in diet to which it has been expoſed. In many animals the effect is perhaps more certain than in man, who ſeems framed for irregularity, and adapted by nature to greater varieties in the modes and circumſtances of life, than almoſt any other ſpecies. The hog, when permitted to range at large, and left to the free indulgence of his undiſcriminating appetite, is ſo frequently found with the liver in a morbid ſtate, that ſome have aſcribed the prohibition of pork among the Jews to this account. It is equally true concerning every other claſs, that this gland becomes diſordered from the ſame cauſe. In reſpect to ſheep, in particular, hepatic affections from alterations of food are perfectly aſcertained. The moſt deſtructive diſeaſe to which they are ſubject, occurring in rank and luxuriant paſtures, is regarded as much connected with diſeaſe in the liver.

Such effects from indigeſtible matter, or from derangement in the digeſtive powers, happening in the liver when other parts do not fall into equal diſorder, go in aid of the opinion, which the anatomical hiſtory of the vena portarum, and reflection on its nature, muſt excite. They conſtitute a ſpecies of evidence which is more than preſumptive; but the production of gall ſtones is ſtill ſtronger teſtimony:

it is a particular affection from the actual application of acid, where correſpondence between the diſeaſe and the occaſioning matter is obvious. We find the cauſe adequate to the effect, the relation between them moſt apparent, and are enabled to follow the progreſs. Various conditions of liver affection may proceed from the varieties of ſtomach derangement, or from vitiated introduction by the mouth, when the operation of the offending matter is obſcure. There may be articles, ſuch as ardent ſpirits, of which it is only known that they become the ſources of diſeaſe: but the alteration from acids upon the bile is devoid of myſtery.

It is in common belief, that ſheep are not only ſubject to diſeaſed livers from peculiarities of paſture, but to have particular kinds of animalculæ in that viſcus, or attached to it. The ova muſt be taken up in food or in water, and their frequency in the liver is in favour of an eaſy intercourſe ſubſiſting between the ſtomach and that gland. If they could only be received by the lacteals, and carried in the round of the circulation, they might be expected in the brain itſelf, and in every other ſituation of the body as commonly as in the liver. A kind of hydatids, which occur more frequently in the liver than in other parts, are looked upon as animalculæ, and may gain admiſſion in the ſame manner. The ſame, however, may ſometimes be tranſmitted to the general maſs of fluids, and depoſited upon other organs which afford a convenient nidus.

It is an obſervation among ſea-faring men, that in particular places the fiſh are poiſonous from feeding upon narcotic weeds, or ſomething deliterious upon the bank; and the liver is conceived to be impregnated with the poiſon in a much greater degree than any other part of the body. Upon an unknown coaſt, where there is doubt in reſpect to the qualities of fiſh, the liver is made trial of for the purpoſe of experiment. If even a ſmall quantity of that gland can be eaten without bad effects, the whole fiſh is conſidered as ſafe food. If it were proved that this remark is founded in juſtice, and that the poiſon of a bank is actually contained in the liver in greater proportion than in other parts, there could not be a ſtronger inducement for believing in direct communication with the ſtomach and inteſtines by the vena portarum. The circumſtance, however, is not advanced as a fact that has been demonſtrated, yet it reſts upon the report of men whoſe relation has been made without any view to hypotheſis. It is not the fiction of a theoriſt, who can adapt every repreſentation to the ſupport of a favourite doctrine; it ſtands upon the more ſubſtantial ground of ſimple obſervation from accidental experience by unprejudiced individuals, who ſpeak of it with much confidence, without having a thought about the reaſon. Acquaintance with other circumſtances reſpecting the liver renders it probable, although of itſelf it is not ſufficiently eſtabliſhed to warrant important concluſions.

Certain medicines adminiſtered by the mouth, produce effects which ſtrongly indicate connection between the liver and the ſtomach. The encreaſed ſecretion by ſome, and conſtriction by others, may be ſuppoſed to proceed from direct application by means of the vena portarum. Among the firſt may be reckoned calomel, as one whoſe operation is attended by circumſtances which render ſuch application moſt probable; and among the ſecond, peruvian bark. The liver may be affected by ſympathy with the ſtomach or inteſtines; as when violent ſickneſs, or ſevere irritation, is induced by any cauſe, there is often a profuſe evacuation of bile, together with other ſecreted fluids which are thrown into the canal. This may happen after the manner in which the ſecretion by the lachrymal gland is promoted by an application to the external membrane of the eye, or that of the ſalivary glands, by a ſtimulus in the mouth. Of the ſame kind may be the operation of calomel in promoting the ſecretion of bile; yet it muſt be remarked, that in its action there is ſomething which does not appear to be entirely on the firſt paſſages. The moſt potent purgatives whoſe operation is upon the canal itſelf, and the mucous glands that open into it, are commonly quick in operation; but calomel, although a very powerful evacuant in the end, has not in general any ſenſible effect for a much longer time than is required by ſimple purgatives. The beſt and moſt frequent operation of this medicine occurs after an interval, which conjoined with the nature of the evacuation, and the decreaſe of fulneſs about the region of the liver, ſo much more conſiderable than is perceived from other purgatives that have cauſed as great a diſcharge, creates ſuſpicion of its having made the circuit of that gland by the vena portarum. Mercury exhibited even by the ſkin, and carried to the liver by the general circulation, becomes a gradual ſtimulant. Mercurial frictions are a principal remedy for liver obſtructions. When we find a full doſe of calomel, or of *mercurius calcinatus*, exerting at once the ſpecific influence of mercury upon the liver, in a manner that makes the operation very diſtinct from that of common purgatives, whoſe action is principally upon the inner ſurface of the canal, we are inclined to believe in immediate contact. Other medicines might come under the ſame ſuſpicion. Antimonial emetics, whoſe operation does not occur ſo ſoon as that of ipecacuanha, make frequently immenſe evacuation from the liver, but the ſtate of diſorder they occaſion in the ſtomach may be ſuppoſed to be the cauſe. Calomel is ſelected on account of its operation being pure, and little connected with irritation in the primæ viæ.

Conſtriction of the ſecretory veſſels of the liver, and conſequent deficiency or detention of bile, is a ſerious inconvenience, ſometimes reſulting from the uſe of bark, and other medicines of ſimilar qualities. The grounds, however, for preſuming application by the vena portarum, are not ſo ſtrong as with reſpect to particular evacuants. Sympathy with the ſtomach, or conſtriction merely of the *ductus communis choledicus*, may be the occaſion; yet the fact ſhould be kept in remembrance, when the functions of that peculiar vein are conſidered.

It ſeems unneceſſary to adduce more argument in ſupport of abſorption by the meſenteric veins. If the quality had not even received ſuch confirmation from other reaſons, the undeniable connection between biliary calculi and acidity in the canal would have placed it almoſt beyond a doubt. Any perſon who has experience in ſuch caſes, or will make inferences from the practical obſervations of others, may be ſatisfied by careful collation of every circumſtance, that gall ſtones have near relation to diſorder in the digeſtive faculties, and acidity reſulting from it. When in caſes only where acid abounds, an effect, which appears to be a chemical conſequence of redundant acid in the liver or gall-bladder, is produced, can we heſitate in ſuppoſing that the acid has been tranſmitted from the alimentary canal? If the means of tranſlation were leſs obvious, and the conveyance as difficult as it is eaſy and direct, the concluſion would ſtill preſent itſelf. Gall ſtones being that part of the bile which is thrown into a ſtate of ſolidity by acids, we muſt either aſſent to decompoſition by an acid introduced, or we muſt ſuppoſe that the original ſecretion has been imperfect, and the reſinous portion ſuperabundant. The firſt is the moſt probable preſumption, and appears to be eſtabliſhed by reſpect to the cuſtomary ſtate of predominating acidity when gall ſtones are generated.

When biliary calculi are ſaid to conſiſt of the reſinous part of the bile, it is not to be inferred that they are in every inſtance the reſin pure and entire. In many caſes there may be a mixture of animal mucilage, or of any other matter that may be blended with the bile when the condition of the liver is diſordered. Sometimes lithiſiac acid may form a part. In ſchirroſities of the liver, the obſtructing matter that pervades the ſubſtance of that gland, looks frequently like the reſin of the bile in conjunction with that kind of glutinous ſubſtance which is yielded by glands under ſcrophulous affection. The curd-like ſecretion of ſchrophula may unite with the precipitated reſin ſo as to deſtroy the texture of the liver. The baſis however of gall ſtones is that matter which appears in a ſolid conſiſtence when acids are mixed with the bile. It is a requiſite of which they are ſometimes entirely compoſed, and without a portion of which they are never formed.

The bile, by its alkaline principle, becomes a guard upon acidity, and as the quantity ſecreted may vary with circumſtances, the effects from acid will likewiſe be different. Biliary concretions proceed from the ſame ſources as

gravel

gravel and gout, but theſe diſeaſes are not of neceſſity always preſent in the ſame habit. Towards the production of every diſeaſe there are circumſtances of particular pre-diſpoſition and peculiar fitneſs, which co-operate with the prime cauſe. In different habits the powers by which impreſſions, or effects that tend to produce derangement, are counteracted or repaired, appear very different. A concretion of the particles of the reſin may be promoted or retarded by qualities of the bile, depending upon the ſtate of the liver, by local conformation, by the actions of the ſurrounding parts, by habits of indolence or activity, and by other reaſons which it may not always be poſſible to aſcertain. The liver is by nature an inert organ, but in many it may be more inert, and endowed with leſs faculty of exertion for its own defence, than in others.

Liver complaints are moſt prevalent in warm climates, and ought probably to be in part aſcribed to the cauſe I have endeavoured to eſtabliſh. There may be, from climate alone, a diſpoſition to inflammation of the liver, or an aptitude in that gland to become the ſeat of epidemic contagion. Such aptitudes vary with ſeaſon in this country, ſo that the ſame ſpecific infection aſſumes different forms, and occupies different ſituations at different periods of the year.

The contagion that affects the throat in the winter, and the thoracic viſcera in the ſpring, may fall upon the abdomen in the autumn. A continuance of warmth even here appears to incline to abdominal affection. But too often, in hot climates, there is an impaired digeſtion, and acidity from that cauſe, conjoined with an exceſſive uſe of acids. The acid conveyed by the vena portarum exerts its pernicious effects upon the bile. In the inteſtinal canal, or upon the liver, its principal miſchief is expended; as the freedom of ſecretion by the ſkin ſecures againſt accumulation in the general fluids.

When there is a prevalence of acid in the liver, the particles of the precipitated reſin may be attracted into calculi, or, continuing diffuſed over the ſubſtance of the gland, may ſhut up the finer ducts, and give interruption to the neceſſary and natural functions. Sometimes, at this period, the actions of life are rouſed to increaſed exertion, by which the offending matter is removed. Frequently, by ſlow degrees, a ſchirrus, leſs alarming in the commencement, but more fatal in the iſſue, is produced. The means of relief, when nature effects a remedy, is generally inflammation, which may cauſe the obſtructing matter to be abſorbed, or to be propelled by increaſed ſecretion. Sometimes it terminates in ſuppuration, and the matter burſts into the inteſtinal canal, or makes its way to the ſurface of the body, the liver having adhered to the ſide. A condition of irrecoverable diſorder in the alimentary canal, with habitual jaundice, univerſal derangement, and dropſy in the end, are among the melancholy conſequences of chronic obſtruction.

It may be remarked, that not unfrequently when there is liver obſtruction, and jaundice from bile in the circulation, there is at the ſame an unnatural quantity of that fluid in the alimentary canal. The morbid affection of particular parts of the gland operates by irritation upon other parts that retain the faculty of ſecretion, and ſtimulates to an increaſed diſcharge, which becomes ſenſible in the primæ viæ, when the ductus communis is not rendered impervious. The ſymptoms are in ſome reſpects different from thoſe that occur when bile is wanting in the canal; but the nature and cauſes of the diſeaſe are the ſame, and the methods of treatment not much altered by the particular circumſtances. It were impoſing, however, upon the patience of readers, to enter into a detail of ſymptoms which many have deſcribed with great ability, or to dwell upon the obvious means by which urgent affections ſhould be relieved. The firſt production of diſeaſe, or its recurrence, are the important objects, to the prevention of which a knowledge of the cauſe is to be particularly employed: it is the great end towards which we muſt endeavour to direct the information which experiment and reflection have ſupplied.

SECTION VI.

On Prevention and Cure.

AN accurate knowledge of the firſt alterations that conſtitute diſeaſe, and of the circumſtances by which they were occaſioned, is the ſureſt foundation upon which means of prevention and removal can be grounded. But ſuch knowledge cannot often be obtained. The primitive ſources of many maladies are blended with ſecret and myſterious ſprings of action, which communicate peculiar directions to animal proceſſes, and come not within the reach of poſitive detection. Experience then becomes the ground of practice. Attention to evident alterations, and the obvious ſymptoms of particular caſes, with recollection of their progreſs in ſimilar inſtances, and obſervation of effects from different modes of treatment, form a kind of knowledge, which is the ſoundeſt baſis of the medical art. A moſt beneficial ſyſtem of practice may be built upon ſuch knowledge, without much relation to cauſes that are obſcure and incomprehenſible. Of this kind have been conſidered the cauſes of theſe diſeaſes that make the ſubject of the preſent enquiry, yet experience had ſuggeſted modes of management which have been purſued with ſucceſs, and which better acquaintance with their actual ſources will eſtabliſh and carry to greater perfection.

Such had been the effect of experience upon practitioners, who with diſcrimination and diſcernment acted under its guidance, without being drawn aſide by the miſleading bias of baneful hypotheſis. Others, however, have been influenced by conjecture which was not ſuſtained either by obſervation or experiment. They have aſſumed a viſionary cauſe, and, erecting upon it a baſeleſs fabric, afford memorable example of the danger of acting upon ſuppoſition. Dr. Lobb, conceiving all urinary concretions to be calcareous, had recourſe to acids as a means of prevention. With him, acidity or aceſcency was the teſt of a ſolvent, and his regulations, accommodated to an erroneous opinion, were pointed againſt an ideal alkaleſcency in the fluids. He recommended for the ſolution of calculi, a regimen conſiſting almoſt entirely of acids, and ſubſtances tending ſtrongly to that fermentation by which acid is produced. His line of practice, pregnant with ruin, has its advocates even in the preſent day; but they are few in number. Its evil conſequences are ſo commonly perceptible to patients themſelves, that it is almoſt univerſally exploded in arthritic and calculous caſes; but in liver affections, where the injury produced comes not ſo immediately into view, and where ſymptoms that are accute may ſometimes be relieved by methods which become the occaſion of chronic evil, the pernicious tendency of a ſimilar doctrine is frequently encountered. The ailments that proceed from a depoſition of the reſin of the bile, in the liver or gall-bladder, are daily aggravated by errors of medicine and of regimen.

When an opinion in reſpect to the origin of any diſeaſe is ſupported by probable circumſtances, and ſtrengthened by coincidence with every practical deduction, much advantage may ariſe from it. There are few diſeaſes in reſpect to the ſources of which the evidence is ſo complete, as we have endeavoured to ſupply concerning theſe under conſideration. Our moſt important concluſions are drawn from chemical facts, not too refined for being made the ground of juſt inference, but obvious and unambiguous,

ous. It has been proved, that in the general fluids of the body, or in particular portions of theſe, there is a peculiar matter of the acid ſpecies, which in its common ſtate is combined with ſomething that keeps it ſuſpended, and in a ſtate of ſolution—That this matter is in many caſes redundant, ſometimes perhaps from too great a portion being produced by the animal operations, but more commonly from a precipitation of it by a ſtronger acid, which may be one of the native acids, or an acid conveyed from the alimentary canal—That loſing its combination with alkali or earth, it appears in the urine as a preternatural ſediment under various ſhapes; and, when the proportion is greater in any ſituation of the body than can be retained in ſolution by the fluids of the part, a concretion of particles takes place ſo as to form, in the urinary paſſages, gravel and calculi—in other places, but eſpecially in tendons and ligaments, from circumſtances in their nature and circulation pre-inclining to the effect, a depoſite which becomes the cauſe of gout.

To predominating acidity theſe diſeaſes are to be aſcribed—to acidity which ſometimes may have its origin in the veſſels themſelves: it may be the production of the general habit, or perhaps may proceed from the morbid operations of a part—to acidity which more frequently is generated in the ſtomach—and not uncommonly to acidity introduced by the mouth. It has been obſerved, that theſe ſources of redundant acid are often conjoined, and that the impreſſion from their united influence is aided in its general effects, or pointed to particular directions, by different conditions of contraction in the organs by which ſecretion is performed. The importance of the liver in regulating acidity has been demonſtrated, and the effect of acids upon the bile has not only been found to have connection with their operation upon the other fluids, but to be productive of a different diſeaſe, which gives interruption to functions that are of great conſequence in the body. The ſource of theſe affections is the ſame; the means of prevention will be the ſame; and muſt principally conſiſt in guarding againſt acidity, and counteracting or diminiſhing the operation of acids. It is not our deſign to enter minutely into the methods of carrying theſe intentions into effect, but merely to touch upon general principles, of which the proper application to individual caſes muſt be accommodated to multiplied varieties of conſtitutional temperament, cuſtomary habit, and particular conveniency.

As we are not informed reſpecting circumſtances that relate to the actual production of different proportions of the native acids of the body, we muſt principally be guarded againſt the precipitation of lithiſiac matter by foreign acids, and eſpecially by that which is created in the ſtomach. It ſeems probable, that deviations from the right condition of neutrality, under which neither acid or alkali predominate, has its dependance upon the alimentary canal and the liver more frequently than upon alterations occurring within the blood veſſels, or in the general organs of ſecretion.

The various articles of diet are liable to the different changes that occur ſpontaneouſly in dead matter. When the digeſtive faculties are complete, ſuch changes are reſiſted and counteracted in the ſtomach. Digeſtion is a new arrangement of elements, but of a very different kind from that which takes place in common fermentation. Its products are entirely different from thoſe of the acetous or putrefactive proceſs; but when the requiſite powers of aſſimilation are deficient, or have been impaired, the aliment is apt to run into ſimple fermentation. From this cauſe acidity is preſent in the ſtomach under moſt conditions of debility or diſorder: it is the reſult of common fermentation which a healthy ſtate of the aſſimulating powers does not permit. Such appears to be the general ſource of acid produced in the primæ viæ; but as a different opinion in reſpect to its origin has been maintained, it is neceſſary to enter more particularly into the queſtion. We ſhall chiefly conſider the objections as they have lately been brought together, and ſtated with much ability, by Mr. Moore, in his ingenious Eſſay on the Materia Medica.

The principal argument is grounded upon the ſudden occurrence of acidity after eating, the intervening time being ſuppoſed much leſs than is required for common fermentation. It is contended that acidity in the ſtomach is often perceived within half an hour, while ſeveral days are neceſſary before as complete an acid is produced from the ſame vegetables, even under circumſtances moſt favourable to the fermentative proceſs.

I believe there are few vegetables ſuſceptible of the acetous fermentation, in which that proceſs may not be carried to complete acidity within a period much more limited than that of ſeveral days, or even a ſingle day. The circumſtances under which a vegetable ſolution retains its properties unaltered for a ſeries of days, are not conſtant agitation in a heat of a hundred degrees, under the powerful influence of matter which is already in the progreſs of fermentation. The baker can excite, within half an hour, fermentation that would ſoon run to acidity, in flour with a much leſs conſiderable portion of moiſture than that which is moſt favourable to the change. The proceſs of churning is the formation of a perfect acid in cream; a matter that, of itſelf, remains unaltered much longer than moſt vegetable ſolutions. Freſh cream will retain its properties for many days, yet by agitation and heat the fermentative proceſs is excited without the aid of a ferment, and carried to the condition of acidity in leſs than an hour. Does milk, even at reſt, or the almond emulſion, require days to become ſour, when placed under the influence of the ſun in ſummer? If they are put into veſſels already tainted by fermentation the change is almoſt immediate.

The quickneſs of fermentation in the primæ viæ is not much greater than can be exhibited under leſs favourable circumſtances in other ſituations. But, ſays Mr. Moore, thoſe who credit the acetous fermentation are compelled to ſuppoſe, that there is in the ſtomach a ferment more powerful than any other ferment in nature, and after the admiſſion of that improbability, the ferment muſt be acknowledged to be an acid. It is then granted that the ſtomach ſecretes an acid; and ſince we are in poſſeſſion of this ſource of acidity, why ſhould we have recourſe to a ſecond kind of acid produced by the fermentation of vegetable ſubſtances?

I think reflection upon the proceſſes to which I alluded makes it evident, not only that the ferment is not more powerful in its action than others, but that common fermentation can be carried, in nearly as ſhort a time, to the point of acidity without the aſſiſtance of any ferment. A ferment, however, there is in many inſtances, but that ferment is not an acid ſecreted by the ſtomach. That an acid thrown out by the ſtomach itſelf ſhould be the exciting cauſe of the fermentative proceſs, is indeed, ſo improbable, that I can ſcarcely think the ſuppoſition was ever made. Acid, as a ſpecies, does not tend to excite fermentation which runs to acidity. The greateſt numbers of the claſs are powerful anti-fermentatives. Vinegar itſelf, when perfectly formed, need not perhaps be excepted. The actual ferment is matter already under fermentation, a morbid proceſs which in diſordered ſtomachs is perpetually going on, and, by being continued from meal to meal, communicates a ſimilar diſpoſition to all the freſh matter that is received. A ſtomach of which the functions are deficient is in the condition of a fermenting vat, where matter, in which fermentation is nearly concluded, immediately attaches to its own ſtate every thing capable of ſimilar fermentation. It is not even neceſſary that the ferment ſhould have arrived at the point of acidity. Matter, in the courſe of a proceſs that tends to that concluſion, will be of equal, if not of greater avail than the product when complete.

But acidity is not ſo much perceived after the uſe of vegetables which are ſimply capable of fermentation, as from other ſubſtances which are known to ferment with difficulty, or not at all.

Much ſtreſs is laid upon this laſt argument, but it is eaſily ſet aſide. That butter, expreſſed oils and fat, with other articles, from the liſt of which, however, almonds ſhould be ſtruck out, although abſolutely incapable of becoming ſour, contribute greatly to the acetous fermentation in the ſtomach, is a fact with which every perſon is acquainted. Their action is much more eaſily explained than by ſuppoſing that they cauſe a ſecretion of acid. They give increaſe to that derangement which alone permits the fermentative proceſs to happen in the ſtomach. They add to the diſorder in the digeſtive functions, and there is a conſequent diminution of the powers by which fermentation ſhould be reſiſted. It is by weakening the aſſimulating proceſs, that they become the cauſe of acidity in matter which by itſelf would have been digeſted. The ſame effect enſues from every thing diſagreeable to the ſtomach, or difficult of digeſtion. If two ſubſtances are employed, of which one is unſuited to the preſent powers of the ſtomach, the proceſs of aſſimulation in the other is prevented by the derangement from that to which the digeſtive faculties are inadequate, and common fermentation ariſes in both. Simple animal matter, that by itſelf would have been readily digeſted, ſhall, from conjunction with ſomething offenſive, be thrown up after a length of time unaltered, or perhaps in a ſtate inclining to putrefaction, if the preſence of vegetable matter has not directed the proceſs of fermentation towards acidity.

When proper digeſtion is interrupted by any thing diſagreeable to the ſtomach, or by an unſalutary impreſſion upon the ſound action of that organ from ſudden anxiety, or any other cauſe, common fermentation becomes unavoidable, and the accompanying flatulency affords teſtimony of that proceſs being the ſource of acidity.

The vapour will not be ſuſpected to be a ſecretion from the ſtomach: it is undoubtedly extricated from the contents of that viſcus: it is certain evidence of fermentation, and its emiſſion is very rapid. In many ſtomachs there ſhall be painful diſtention from flatulency, within a very few minutes after a bit of caullyflower has been eaten. The gas is produced ſooner than it can generally be extricated by other means. We need not then be ſurpriſed, if perfect acidity ſometimes occurs rather more quickly than under common circumſtances. The digeſtive proceſs which commences as ſoon as the food has been ſwallowed, produces in the elementary particles of matter an inſtantaneous commotion, which, when it is not regulated by ſufficient powers of aſſimulation, may partly degenerate into ſomething ſimilar to common fermentation. Inconcluſive endeavours at digeſtion may accelerate the other change: the products are not perhaps entirely the ſame as would have been obtained from fermenting the ſame ſubſtances before a fire. There is not an inconſiderable difference in the products of artificial fermentation conducted under different circumſtances; but the acid is derived from the matter of diet, and if there was more ſerious difficulty in reſpect to the quickneſs of its occurrence, reflection upon the very ſudden extrication of air, a ſtage of fermentation, to which acidity may ſoon ſucceed, muſt ſatisfy us in regard to its ſource.

Boſc D'Antic, in his *Memoire ſur les differens Etats de l'Acide dans l'Economie Animale*, conceives the acid of the ſtomach to be phoſphoric, and goes the length of aſſerting that it does not form with alkalis the compounds that would reſult from their union with vegetable acid. "*Il n'eſt pas rare que les hypochondriaques, les femmes hyſtériques, les femmes encientes éprouvent des aigreurs dans l'eſtomac et dans l'æſophage, et rendent meme par le bouche une liqueur tres-acide. Un léger purgatif, en emportant la ſurabundance de cet acide, les délivre, du moins pour quelque temps, de cette incommodité. Cet acide ne faiſant pas efferveſcence avec les alkalis aérés, et ne formant evec l'alkali fixe du tartre, ni de la terre foliéc, ni du tartre tartariſé, ne ſauroit être regardé comme un acide végétale.*" If he really examined the neutral compounds, it is ſurpriſing that he had not carried his inveſtigation ſo far as to be able to give poſitive teſtimony of the acid being phoſphoric. But his general reaſoning, throughout the whole eſſay, is ſo little connected with actual experiment, and ſo much adapted to opinions viſionary or incompatible with the animal œconomy, that he cannot be regarded as ſtrong authority. His obſervation in reſpect to the want of efferveſcence with mild alkali, is evidence of the ſuperficial grounds upon which he formed concluſions.

There is a particular ſecretion from the ſtomach of a fluid neceſſary towards digeſtion—a fluid poſſeſſing the extraordinary coagulating properties of rennet. That it may ſometimes partake of the nature of acidity (although that it is not actually an acid appears from the experiments of Dr. Young, who found it in force after the ſtomach had been waſhed with diluted alkali), or that ſuperabundant acid may, in particular caſes, be blended with it, I would not preſume to deny: but that the vaſt production of acid, which is the ſource of ſo much inconvenience in the ſtomach itſelf, and carries injury with it to the alimentary canal, to the liver, and even over the ſyſtem, is the conſequence of fermentation in the vegetable part of diet, appears evident from every conſideration.

Attention to different effects, from ſubſtances under different circumſtances, is entirely in favour of this opinion. It is well known, that diluted conditions of fermentable ſubſtances, ſuch as ſugar, wine, and the juice of fruit, are more apt to occaſion acidity and flatulency than the ſame undiluted. A ſtate of dilution is favourable to the fermentative proceſs. The pulp of an orange ſaturated with as much ſugar as it can imbibe, ſhall often be readily digeſted in a ſtomach where liquid does not happen to abound, when the greateſt inconvenience will be endured from either the ſugar or the juice with a conſiderable addition of water. If the orange juice, or the ſugar, or wine of any kind, occaſioned a ſecretion of acid, they might be expected to produce the greateſt impreſſion when applied in a concentrated ſtate; and the pure water is ſurely innocent. It is within common obſervation, that fermented liquors prove inconvenient in proportion to the degree of exiſting fermentation, or aptitude to the renewal of it. It is aſcertained that new bread, in which fermentation has ſcarcely ceaſed, will run into acidity, when ſtale bread, in which it is at an end, or when bread which has been toaſted till the diſpoſition to fermentation is deſtroyed, ſhall fall into proper aſſimulation. And here I muſt diſſent from an opinion of Mr. Moore, who muſt admit towards himſelf the ſame freedom of diſcuſſion which he fitly aſſerts in canvaſſing the opinions of others. He conſiders unfermented bread from flour as more apt to occaſion the production of acid, than ſuch as has been fermented. The remark ſeems to be in oppoſition to univerſal experience in reſpect to ſimple biſcuit, which is not much inclined to acidity, and on that account not uncommonly ſubſtituted for fermented bread with a medical view, eſpecially in the diet of children.

It is certain, that the articles of diet moſt diſpoſed to common fermentation, are thoſe which become, in general, the principal cauſes of acidity in the primæ viæ, and that they contribute in the greateſt degree to that effect, when they have been employed in the ſtate beſt adapted to fermentation. The inconvenience from them is nearly the ſame in every ſtomach under a condition of debility or derangement. Cabbage or peaſe ſeldom fail to occaſion flatulency in a ſtomach whoſe functions are imperfect, or ſmall-beer to become ſour; but rice, a ſubſtance which is not prone to fermentation, is uniformly well received, and proves a valuable article of diet when digeſtion is impaired. There is not any exception to the rule, but in regard to ſubſtances very difficult of digeſtion, yet unſuſceptible of acidity. Their action however was eaſily accounted for: they infringe upon the little remaining tone by which fermentation ſhould be reſiſted, and leave to the acetous proceſs uncontrolled the vegetable matter that is inclined to it.

It may be mentioned, that when bilious and acid vomitings take place, the graſs green colour of the fluid evacuated has moſt reſemblance to the alteration produced upon bile by vegetable acid.

When the ſtomach contains not any thing capable of the acetous fermentation, I believe there will not be much complaint from the preſence of acid in that viſcus, but another fermentation, the putrefactive, may ariſe, and perhaps with greater prejudice to the general ſyſtem. It is poſſible, however, that when the ſtomach is free from vegetable acid, or any thing ſuſceptible of acidity from fermentation, there may ſometimes be, from particular ſtates of the œconomy, a preternatural production of the native acids within the circulation, ſo that the ſecretions ſhall contain redundant acid. Such acid, however, is always obſcure, and too much diluted to be made eaſily manifeſt; it does not feel ſharp in the mouth, or ſet the teeth on edge, like the acid of the ſtomach.

The prevention of acidity from fermentation in the ſtomach is to be effected by regard to diet, by avoiding every circumſttnce that might contribute to diſorder, and by increaſing the proper faculties of digeſtion. To a ſtomach in the right exerciſe of its powers, cautious ſelection of diet is not neceſſary; the aſſimulating proceſs extends equally over the matter of animals and vegetables, to the production of fluids for the nouriſhment of the body. A diet purely vegetable would not give occaſion to preponderating acid, nor would inconvenience be endured from the putreſcent bias of an animal regimen; but we before remarked, that an imperfection in the digeſtive functions is an original error of many habits, which are frequently in other reſpects of great apparent ſtrength. A great proportion of the people in this country, and perhaps over the globe, are conſtitutionally deficient in the aſſimulating proceſs. Digeſtion, which when complete does not admit of common fermentation in the firſt paſſages, is but half performed, and acidity or putrefaction, with their extended train of evils, are perpetually taking place. To ſtomachs of this deſcription—and ſuch are the ſtomachs which may be termed the hot-beds of gravel, of gout, and of biliary affections, the greateſt circumſpection is neceſſary in reſpect

ſpect to the quality and quantity of every thing received.

A diet of milk and vegetables has frequently been recommended for the prevention of gout. If by abſtinence from every kind of animal matter but milk alone complete digeſtion was ſecured, acidity from fermentation would be avoided; there would not then be any ſuperabundant acid from an aceſcent regimen. The healthy infant, that ſubſiſts entirely on the ſound milk of a healthy mother, is not tormented with acidities while the duties of the ſtomach are in perfection; but if artificial diet, to which digeſtion is inadequate, be attempted, there will frequently be immediate diſorder, and conſequent acidity of the natural food, although the offending ſubſtance may have been animal matter. Such is often the condition of adult ſtomachs under debility or derangement. Milk, with rice and other farinaceous matter from ſeeds and roots, and perhaps the mucilaginous ſubſtance of other vegetables, with excluſion however of all thoſe that are greatly diſpoſed to flatulency, would generally be digeſted in ſtomachs accuſtomed to the uſe of them, if employed by themſelves, and unexpoſed to the riſque of that diſorder which one diſcordant article of precarious variety will frequently excite. To a diet of this kind would likewiſe appertain the advantage of being little adapted to occaſion plethora, a pregnant ſource of diſorder in the ſtomach. With ſuch a diet the general ſecretions would not commonly be deficient, ſo that accumulation would be avoided.

Compliance, however, with ſuch rigid reſtraint, unleſs there is abſolute decrepitude, or a perfect inability in the ſtomach to digeſt more ſubſtantial food, is ſcarcely to be expected. The ſtrongeſt propenſity of the appetite is for animal matter. In the ſubſtance of animals, regarded as diet, there is diverſity of qualities. Many kinds of animal food are very eaſy of digeſtion, while others require the powers of the ſtomach to be in full tone. With cautious choice in reſpect to the inherent qualities, and circumſpection in dreſſing, as properties are liable to much variation from cookery, the matter of animals muſt in general form the principal part of diet in dyſpeptic caſes, and the greateſt number of vegetables muſt be interdicted.

Simple animal matter, of which the flavour is not offenſive to the ſtomach, the fibre not very coarſe, the texture not too rigid, and the nature not luſcious or greaſy, with a circumſcribed allotment of ſome ſelect vegetable ſubſtance of the farinaceous kind, appears the ſort of diet commonly beſt accommodated to a weak digeſtion; and in much more moderate portion than that which ſenſual gratification induces men to devour, would not only give reaſonable ſatisfaction to the appetite, and ſecure againſt flatulency from emptineſs, but conduce better to the proper ſupport of the body than a load of articles, which may appear ſeparately innocent, but become injurious from quantity. The ſtomach, under the ſtate to which theſe obſervations ſhould be applied, ſeems to act better on ſolids than on ſlops, and while, from unnatural inclination or vitiated habit, it often courts diſtention with any thing, it never fails to ſuffer for the indulgence. Solidity is a condition of matter not unfavourable to the digeſtive proceſs, but ill adapted to common fermentation, to which fluidity pre-diſpoſes. It muſt, however, be admitted, that there are caſes of extreme derangement (inſtances frequently occur in jaundice), under which the digeſtive faculties ſeem to recoil at every thing ſolid, and thin animal ſolutions, to which rice is commonly an agreeable and uſeful addition, become the moſt beneficial ſuſtenance. If the alimentary ſupply during a fit of the gout, until the ſtomach had recovered its functions of aſſimulation, were to be almoſt entirely of the ſame kind, conveyed frequently, and in ſmall quantities, there might not be ſuch frequent reaſon to complain of the criſis being incomplete, and of indegeſtion and deficient ſecretion, the ſources of relapſe without end, continuing beyond the progreſs of the paroxyſm.

Whatever may be the diet, the great object is perfect digeſtion. General diſorder muſt be avoided by rejection of every article that is known to be difficult of digeſtion, and apt to interrupt the progreſs of that operation in other ſubſtances. Experimental attention to each particular caſe ſhould point out particular regulation, and whatever has been found to diſagree ſhould be condemned. If we were to enumerate the articles that are inadmiſſible in many caſes of *dyſpepſia*, the catalogue would be alarming to readers who take delight in the pleaſures of the table. It is ſufficient to obſerve that patients, from endurance of different effects, are commonly ſufficiently able to judge for themſelves, and do not require to be informed that wherever there is any kind of uneaſineſs during digeſtion, or nauſea, flatulency, and heart-burn at other times, or that kind of head-ach that depends upon the ſtomach, there is error either in the quality or quantity of diet. When, with ſuch ſymptoms as theſe that have been enumerated, the urine, upon cooling, depoſites red ſand, or a ſediment producing turbidneſs, or betrays, as ſoon as it is diſcharged, a fœtid ſmell like to that which ariſes when an acid has been added, there is certainty of acidity being ſuperabundant in the primæ viæ, and over the ſyſtem. Aceſcency of diet is a quality that ought then to be principally avoided.

When the digeſtive faculties are conſtitutionally bad, or have been impaired by irregularities, there are various methods by which they may be brought into better condition. The choice of food is not always in our own power, as the occurrences of life may reduce us to the neceſſity of occaſionally employing ſubſtances moſt adverſe to our habits, and repugnant to our wiſhes. If the digeſtive powers can be increaſed, there will be leſs injury from improper diet when employed through neceſſity or inattention. It is of the utmoſt conſequence to get a diſpoſition to indigeſtion corrected, becauſe it is apt to produce in the other functions general derangement, and becomes the cauſe of its own continuance. Improper fermentation,

mentation, as was lately obſerved, is apt to be communicated to other ſubſtances mingling with the matter already in a fermenting ſtate. Emetics, by evacuating the offending matter, are often of ſervice.

Weakneſs is a term commonly applied to every caſe of defect in the digeſtive powers. In general the affection is rather diſorder than ſimple weakneſs, or vitiated action than imbecillity. The cauſe of that diſorder ſhould be traced, and the particular nature of individual habits conſidered. We ought alſo in every caſe to take into account the condition of the liver, as it has appeared that the bile is a fluid of great importance in the alimentary canal. The greateſt advantage may ſometimes be obtained from ſuch remedies as influence its ſecretion, or obviate accumulations of it. Antimonial emetics and calomel may be reckoned among the moſt uſeful means of effecting theſe intentions. The laſt is leſs precarious than violent vomiting, which a concomitant plethoric ſtate of the ſyſtem ought frequently to forbid. Many appear not averſe to the effort of vomiting in plethora, even when there is an increaſed diſtribution of fluids to the head. They act as if an emetic might be a prelude to the treatment of every diſeaſe.

That Dr. James was of a different opinion is obvious from the injunctions he lays down for the removal of fulneſs, by the loſs of blood, or by evacuation from the inteſtines, before the exhibition of his powder, with the riſque of vomiting being excited, is commenced in full habits. That vomiting is ſeldom of advantage in plethoric caſes, when the ſtomach affection is often ſymptomatic of general diſorder from univerſal fulneſs, and that it is commonly prejudicial when there is particular repletion in the head, is a fact that every man of experience and accurate obſervation muſt have aſcertained. The ſeverity and danger of the effort is not often counterbalanced by the diminution of action from ſickneſs, the diſcharge of fluids from the ſyſtem, or the tendency to relaxation upon the ſurface after the operation of vomiting. Calomel is not liable to the ſame objections: its operation may be of ſingular utility.

Of antimonials and calomel employed to move the ſtomach or bowels, it may be ſaid, that they are remedies from which, under judicious adminiſtration, admirable effect may be derived. It is too common, however, for perſons with whom indigeſtion is a habit, to fly to emetics, or draſtic purgatives for relief;

and remedies which ſhould only be regarded as extraordinary reſources, are imprudently called into action upon every indiſcretion. The benefit or riſque from medicines of this kind, muſt depend entirely upon peculiarities of habit, and upon the circumſtances under which they are employed. In many inſtances they are commonly inadmiſſible, and in others, where a prudent exhibition of them, combined with other means of obviating diſorder, and promoting the proper functions of the digeſtive organs, might be directed to the beſt effect, they are exceedingly abuſed.

A variety of medicines may be employed for promoting the action of the ſtomach. Bitters have long been diſtinguiſhed for this effect: chalybeates are of great avail. Aromatics, the medicines termed anti-ſpaſmodic, and warm reſinous ſubſtances, may be turned to good account. The greateſt caution is neceſſary in the uſe of ſuch articles—they are active engines, by means of which much good or evil may be atchieved: they ſhould never be employed at random, but ought in all caſes to be under judicious regulation and management, by which their operation may be pointed to a ſecure and ſalutary iſſue. They are powerful in correcting a diſpoſition to acidity; but in reſpect to theſe and ſimilar medicines it may be obſerved, that they are only to be occaſionally called to the aſſiſtance of the ſtomach. The greateſt misfortunes have ariſen from their long continued uſe. There cannot be a practice more pernicious, than the conſtant employment of any medicine which maintains artificial exertion, until the habit of natural action is loſt, and in the end the powers are exhauſted. To bitters, likewiſe, it may be objected, that they are generally connected with aſtringency, and do not contribute to ſecretion. They add to a plethoric habit, which is already a diſeaſe, and may encreaſe to a moſt fatal concluſion. It is not by medicine chiefly, but by regulation of diet, that aſſimulation is to be inſured. There cannot be hope of amendment while free indulgence is given to a luxurious appetite.

The uſe of bitter and ſtimulating medicines becomes leſs precarious, when it is conjoined with means by which a plethoric tendency is avoided and ſecretion promoted. Among theſe may be enumerated regular exerciſe, which is, of itſelf, a principal mode by which digeſtion may be improved. It maintains external circulation and univerſal action. By making a waſte of fluids, it renders a greater ſupply neceſſary, and the digeſtive powers are exerted to ſatisfy the demand.

There are many medicines that contribute towards freedom of ſecretion: one of the beſt is ſarſaparilla, whoſe operation, inſenſible in its progreſs, although ſure in the end, is never injurious to the body, but generally beneficial. To a decoction, of which ſarſaparilla was the chief ingredient, Sydenham has aſcribed the virtues of preventing both gout and gravel. It is uniformly innocent, and frequently efficacious, in removing morbid affection. While it promotes natural functions, eſpecially of the glandular kind, and tends admirably to the right condition of the ſkin, it diminiſhes the unnatural exertion of a feveriſh habit. There is frequently ſome care neceſſary to prevent it from becoming flatulent. When conjoined in decoction with the reſinous woods, it is rendered more grateful to the ſtomach, while the ſtimulating properties of the other articles are diveſted of riſque.

Antimonials and mercurials may be ſucceſſfully exhibited in ſmall doſes, ſo as to operate with good effect on the ſecretory organs in general, and the capillary enhalants on the ſurface. Neutral ſalts are likewiſe of advantage,

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and the alkaline baſis of ſuch ſalts is of great avail. Warm bathing, or the application of vapour to the body, may be employed in many caſes with particular benefit. Remedies of this kind are not only of ſervice in guarding againſt the injuries that might reſult from bitter, aſtringent, and ſtimulating medicines, employed with a view towards increaſing the digeſtive faculties, but, when acid is ſuperabundant, contribute greatly towards the prevention of that accumulation which is the occaſion of diſeaſe. We have ſeen that accumulation is not poſitively the ſource of gout, but becomes one of the moſt active coadjutors of its firſt cauſe.

While meaſures are purſued for the prevention of acidity, it is obvious, that the uſe of acids in diet, or in the liquors that are drank, muſt be put under ſtrict limitation, or entirely proſcribed. The habit of employing acids may be almoſt confined to the uſe of fruits and of fermented liquors. Fruits, from the profuſion with which they are ſcattered upon the earth, and the avidity with which they are deſired, may be conſidered as part of that provender which is furniſhed by nature. Fermented liquors are the products of art, but not to be objected to on that account. Man was not intended to live in a ſtate of nature—he is endowed with faculties that were to be exerted in the modification and diſtribution of objects for his own gratification and advantage. Artificial life is his proper element; in the purſuit of it, however, he may ſometimes be diſqualified for what would be adapted to a condition of nature, and not unfrequently his endeavours at refinement may lead to his own detriment and deſtruction.

That fruits are deſigned to be a part of the food of man cannot be doubted. In ſtomachs adapted to the uſe of them, they afford nouriſhment, and are conducive to health. Such as may be ſuppoſed to be intended to be eaten, contain, when in a ſtate of perfect ripeneſs, very little acid, and that which remains, is regarded as capable of undergoing the digeſtive proceſs, ſo as to be altered in its properties before it can have paſſed from the ſtomach. But when the powers of that viſcus happen to be deficient, or unſuited to the aſſimulation of ſuch matter, the full effect of the acid is exerted upon the inteſtinal canal, the liver, and the fluids of the body. This is not the only inconvenience: the pulp or mucilage, in common with vegetable ſubſtances, is liable to theſe fermentations, from which proceed acidity, flatulency, and other ſymptoms of derangement. In this manner ar-

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ticles, which to a ſound digeſtion are not only innocent but wholeſome, become pregnant with miſchief when the aſſimulating faculties are defective or impaired.

Fermented liquors, from their impreſſions upon body and mind, may be ranked among the higheſt luxuries which human induſtry has been able to provide. The art, however, of fermentation is one of thoſe which may be ſaid to be proſecuted as much to the prejudice as to the advantage of mankind: its products, too uniformly grateful, are apt to be abuſed. Acidity is one objection to which many are liable, and thoſe that have the leaſt of it ſhould be preferred when there is diſeaſe from prevalence of acid. Soft ale may be an innocent beverage, when cyder would prove extremely injurious; or madeira a ſafe and grateful ſtimulant, when even a few glaſſes of French wine would occaſion ſenſible detriment. A tendency to run readily into fermentation in the firſt paſſages, is a quality of the weaker fermented liquors, and ſhould preclude many from the uſe of them. Good malt liquor is ſcarcely ſubject to exception on any other ground; but this alone is frequently ſufficient to make a neceſſity for perfect abſtinence from it, and unfortunately even the ſoundeſt wine, in a ſtate of dilution with water, will ſometimes be apt to run into the ſame error, when the functions, by which common fermentation ſhould be reſiſted, are very incomplete. The diſtilled products from fermented liquors are exempt from the defects of acidity or aceſcency, but open on other accounts to weighty objections, which render neceſſary the moſt guarded circumſpection in the uſe of them.

It may perhaps be contended, that acids are not only innocent towards many habits, but uſed with advantage in food and medicine. Although reflection upon the nature of the bile, and its important functions depending upon its ſaponaceous properties, ſhould diſſuade from the inconſiderate uſe of acids, it is far from the deſign of this work entirely to expunge them from the catalogues either of luxury or medicine. Under many circumſtances, the moderate employment of them may be not only inoffenſive but ſalubrious. The acid of fruits and vegetables is ſcarcely to be conſidered as an acid in its effects, when the powers of the ſtomach are adapted to its aſſimulation. Other acids are not perhaps unſuſceptible of change in the œconomy, as acids in general are compounded bodies. Under particular ſtates of habit, their

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decompoſition may be effected by the animal powers in the ſtomach, or in the circulation, and their conſtituent elements diſtributed to other purpoſes. The tranſmutation, or new modification of the particles of acid by the ſyſtem, is a doctrine ingeniouſly ſuſtained by Dr. Beddoes, in his refined ſpeculations reſpecting the extenſive influence of oxygene, and of ſubſtances in which it is contained. In regard to all, however, but vegetable acid, it is to be conſidered as an idea ſtanding at preſent upon no better baſis than conjecture, although the admiſſion of it would ſometimes be convenient in accounting for different effects from acidity, on the ground of inequality in the powers of decompoſition.

But without depending upon ſuch decompoſition and new elementary arrangement, which with reſpect to many acids is improbable, and which even the different kinds of vegetable acid frequently evade, acids are ſometimes uſeful remedies in diſeaſe. They may be numbered among the moſt effectual ſedatives to inflammatory action, and are entitled to conſiderable praiſe in hæmorrhages, whether active or paſſive. While they tend to leſſen the cauſe of unnatural impulſe, they exert a mild aſtringency.

Acids have been extolled in medicine as antiſeptics: they certainly are of avail in many caſes where ſeptic tendency has been ſuſpected. But it may admit of diſpute, whether the prinpal benefit be from reſiſting the malignant bias of putrefactive ferment, or from ſedative powers allaying inflammatory irritation which diſpoſes to diſſolution, alarming and rapid in proportion to its violence. That the antiſeptic operation may depend upon the ſedative virtue, is rendered probable by reflecting upon the different effects of ſtimulating anti-putreſcents, which are not employed with univerſal ſecurity, but in numerous inſtances cauſe aggravation of an evil, proceeding as often from error of action and extraordinary excitement, as from mere languor and debility of the animal functions. There is not any thing in phyſic concerning which it is neceſſary to make more correct diſtinction than in reſpect to extreme proſtration, depreſſion, and irregularity of action, of which a phlogiſtic ſtate, with appertaining congeſtion to the brain, or ſome other vital organ, is not leſs commonly the ſource, than a low and properly ſeptic condition of the habit.

Acids are applicable to ſome caſes of ſtomach diſorder, and may be turned to account in reſtoring the digeſtive faculties. When from accidental irritation there is an augmented ſecretion of bile, which aſcends to the ſtomach, and diſplays itſelf by nauſea and vomiting, acids, by decompoſing the offending matter, ſometimes diminiſh the inconvenience. Too often, however, the cauſe of ſuch increaſed ſecretion is predominating acidity, and the bile, when thrown up, is already decompoſed: it appears a fluid not yellow, ſaponaceous, and viſcid, but green, and brittle. The mineral acids tend to promote the natural operations of the ſtomach, and may become correctors of acidity. By giving tone to that organ, they may prevent a production of acid, which would perhaps in quantity have been ten times greater than that which has been uſed medicinally. Of this nature may be the effects of a few drops of vitriolic or muriatic acids, which, as ſoon as they enter the duodenum, are neutralized by the bile, and become inert.

The action even of acids upon the liver, when obſtruction is a diſeaſe, may be ſuppoſed ſometimes to prove ſecondarily beneficial; as in certain ſtates of diſorder an increaſe of derangement will ſtimulate the reſtoring faculties to exertion, and conduct to theſe conſtitutional proceſſes by which oppreſſion is overcome. In the ſame manner, a copious introduction of acid may produce, in a diſordered habit, a regular fit of gout which ſhall terminate in ſound health. But although circuitous and accidental advantages may ſometimes occur, acids are to be uſed with the moſt jealous caution in ſuch caſes. They are indirect and uncertain remedies of dubious operation, and ſeldom can be innocent if they are not of advantage.

It is not from a little vinegar, or a ſmall quantity of acid in medicine, that much miſchief is in general to be apprehended, but even the moſt reſtricted uſe of acids is precarious where acidity abounds. Many, whoſe fluids are framed to yield but a ſmall portion of lithiſiac matter, may indulge in acids without incurring riſque of gravel or gout; and from cuſtom the ſecretion by the liver may be in a certain degree accommodated to ſuperabundant acid in the canal, as there is in the œconomy a wonderful faculty of being reconciled to artificial circumſtances; yet it may in general be remarked, that acid medicines, or compoſitions in which acidity predominates, do not well accord with habits that are prediſpoſed to gout, to gravel, or to biliary concretions. That they are too cold for the ſtomach, is the vulgar language by which patients expreſs the injury they have experienced. Acids may be innocent towards a clear and florid countenance, but are not well ſuited to a ſallow complexion and jaundiced eye. To ſuch conſtitutions, alkalis and the earths termed abſorbent are better adapted. It is impoſſible to read without concern of ſuch a man as Dr. Johnſon perpetually ſipping acid or aceſcent liquors, while he was groaning under the anguiſh of gravel, or ſliding into a fatal dropſy which probably proceeded from a morbid liver, to the diſorder of which his unfortunate indulgence was adding ſtrength.

In favour of acids it ſhould be ſtated, that they do not add to the evils of plethora, but rather tend to obviate its occurrence; and that the quantities of aqueous fluid, which generally go along with them, contribute ſo much to the dilution of the urine as to make ſome amends for the precipitation of lithiſiac acid. In proportion as the urine is diluted, a larger quantity of that acid, although ſeparated from the matter with which it ſhould be combined, will remain ſuſpended, or in a ſtate of ſimple ſolution. Acids then are not without merits. Their condemnation is not intended to be unqualified, although they are generally prejudicial under particular circumſtances. In phyſic it has been much a faſhion to make of every new principle an indiſcriminate application, which is the bane of improvement. Syſtems that, under proper confinement, were ſtrictly juſt, have often been brought into contempt and neglect by the diſappointment and diſguſt enſuing from abſurd and inappoſite extenſion to points which they could not comprehend.

If attention to methods, by which the proper action of the ſtomach is promoted, be accompanied with neceſſary regard to diet, and with guarded abſtinence from acids, ſuperabundant acidity in the primæ viæ may, in general, be avoided. When, however, the tendency to diſorder is exceſſive, or has been of long ſtanding—when it proceeds from digeſtive faculties too much vitiated or debilitated to be effectually recovered—when it is connected with diſeaſe which cannot be removed, or with irritability and anxiety of temper which regulation cannot reach, common fermentation in the vegetable portion of diet will be unavoidable, and there will be a formation of acid in ſpite of every endeavour to prevent it. In ſuch caſes, it becomes neceſſary to ſecure againſt the effects of acidity, by the deſtruction of it. Alkalis and abſorbent earths combine with the acid into a neutral ſtate. They are often employed with peculiar benefit, and have even acquired the reputation of ſolvents for concretions in the bladder. But their pretenſions to be conſidered in that light, together with their general effects, are of ſufficient importance to be made the ſubjects of a ſeparate ſection, concerning which the epicurean reader, weary of injunction reſpecting requiſite reſtriction and abſtinence in regard both to diet and certain favourite acidulous compounds, may perhaps be happy to be informed that it is the laſt.

SECTION VII.

On the Power of Solvents, with general Obſervations.

A SOLVENT for a ſtone in the bladder is one of the grand *deſiderata* of medicine, to the attainment of which the art and ingenuity of practitioners have always been directed. Many articles have enjoyed a momentary reputation, for which they were indebted merely to the ſimplicity or ignorance of perſons who drew concluſions in their favour without any rational acquaintance with their actual powers, or with the matter on which they ſhould operate: like popular remedies that are often cried up for the day, and then dwindle into inactivity or appear deſtitute of virtue, they have in ſucceſſion returned to the obſcurity from which they ſprung. But alkalis are to be excepted from the fate of common oblivion, to which ſolvents of various deſcriptions have been conſigned. They have not always been held in equal reſpect; for at different times they have been in high eſtimation, and have afterwards fallen into diſcredit. In general, however, they have maintained a degree of character, which has been the ſource of fame and fortune to ſome by whom they were ſecretly adminiſtered, and would appear to imply a portion of ſucceſs, without which they muſt ſoon have ſhared neglect with the others.

The ſolvent character of alkalis lays claim to greater attention from ſeeming to have depended more upon experience than theory. The deductions of reaſon were generally againſt them, and have been employed for the ſubverſion of properties to which the faculties of reaſon could not be reconciled. It may be a matter of diſpute, whether the rejection of their title to ſolvent virtues has been made upon the juſt ground of inefficacy, or from falſe deduction ſupported by miſtaken notions of the nature of calculi. Miſconception, or the error of argument that is raiſed upon unjuſt poſition, will ſometimes prevail over the teſtimony of obſervation and experience.

When calculi were ſuppoſed to be an earth, of which the particles were kept together by animal mucus, it appeared improbable that alkalis,

kalis, after many opportunities of being ſaturated with mucilaginous matter during a tedious circuit, ſhould arrive at the kidnies in condition for uniting with any portion of the cementing medium, and it was obvious they could not act upon that kind of calcareous ſubſtance, which was then conceived to be the baſis of the ſtone. But when the real nature of urinary concretions, with the mode and cauſes of depoſition, is conſidered, the operation of alkalis upon calculi in the bladder will not be thought ſo unlikely or remote. If the ſource of concretion be a redundancy of acid, it cannot be denied that an alkali may be exhibited for the effectual correction of it. Whether the acidity be from the firſt paſſages, or from cauſes within the circulation, alkalis may, in that reſpect, be rendered of certain avail. They may be made to ſuperabound in the fluids: there could not then be any depoſition of lithiſiac acid. The petrifying quality of the urine being deſtroyed, there muſt be an end to chryſtallization; and as the calculus is ſoluble in water, a very ſlow but gradual diminution might be effected, by the urine itſelf not now containing any redundant acid. For it is a fact, that natural urine, not only does not of its own accord make a depoſite of lithiſiac matter when air is ſhut out, but in the heat of the body is capable of uniting with a minute proportion, ſo as to become the ſolvent of a ſtone.

Such would be the effect from urine of which the petrifying proceſs was ſuperſeded; but if an alkaline impregnation can be conveyed to that fluid, its qualities of ſolution will be rendered more conſiderable; and that an alkaline impregnation may be communicated, is capable of demonſtration by a very ſafe and eaſy experiment. Half a drachm of common *kali preparatum*, or ſalt of tartar, exhibited in a glaſs of water every two hours, will become very manifeſt in the urine after the third or fourth doſe. It will firſt be perceived by a precipitation of the earth that is combined with acids in the fluids. I have obſerved, after a few hours, that not only the whole of that earth was precipitated, but the alkali redundant in a ſufficient degree for giving a green colour to the ſyrup of violets. The precipitate of earth appears, not merely in the urine when cold, like a lithiſiac ſediment, but in that fluid as it flows from the bladder. It is a white powder, which ſettles almoſt immediately to the bottom, and is readily ſoluble in acids.

The ſolvent powers of urine would not be much increaſed by the preſence of mild alkali, ſuch as was mentioned in the laſt experiment; the attraction of carbonic acid to alkalis being ſtronger than that of lithiſiac matter; and cauſtic alkalis, by themſelves, are held to be too acrimonious for internal exhibition. But cauſtic alkalis may be conveyed to the urine, in conjunction with ſomething by which they are leſs attracted than by the acid of urinary concretions. They may be united with oily or mucilaginous ſubſtances, from which they will ſeparate to combine with lithiſiac acid. The compound of an alkali with any matter, towards which it is not drawn by ſo ſtrong an affinity as to concreting acid, will form a menſtruum, by which, if carried to the urinary paſſages, a ſtone in the bladder will be diſſolved.

With a view of aſcertaining the comparative degrees of attraction to alkalis between expreſſed oils and concreting acid, I made the following experiment: A ſolution of ſoap was prepared by boiling twenty grains of *ſapo amygdalinus* in two ounces of roſe-water, and as ſoon as it had been removed from the fire, five grains of the chryſtals of pure lithiſiac acid were added to it. Upon agitating the vial, I obſerved that there was an evident decompoſition of the ſoap; for the fluid, which till then had been nearly tranſparent, became in appearance like cream. The ſeparation of the oil was not ſo complete as it would have been if any of the common acids had been employed. The particles neither aroſe to the ſurface or ſubſided to the bottom. The mixture, in which the ingredients remained blended together, had a ſtrong reſemblance to the milky compounds produced by agitating expreſſed oil with a diluted ſolution of alkali impregnated with carbonic acid. The alteration, however, was ſufficient to point out a chemical change, and in a ſhort time the lithiſiac acid was entirely diſſolved. If the urine, therefore, can be rendered a ſaponaceous fluid, it will become a menſtruum for a calculus.

When an alkali, either by itſelf, or in conjunction with any matter to which it has not ſo ſtrong an attraction as to the native acids of the body, has been received into the fluids, the firſt effect from it muſt be a decompoſition of the earthy ſalts. A portion will be expended in uniting with the acids from which the earths have been detached: but if the quantity exhibited be more than ſufficient for the ſaturation of theſe, the other part will remain unaltered, and may be ſecreted by the kidnies. Thus, from theory, we might conclude, that the urine may be impregnated with ſubſtances of this kind, and experiment accords with deduction. An inconſiderable portion of alkali taken into the ſtomach, will convert the urine from a condition of ſuperabundant acidity, under which there is a lithiſiac ſediment, and an emiſſion of fœtid vapour, to a ſtate of neutrality, remaining tranſparent when cold, and without any offenſive odour. A larger quantity becomes more manifeſt by a precipitation of earth. Let any incredulous lithiſiac ſubject make the trial, and he muſt be ſatisfied with the event.

It appears from the obſervations of many authors, who have made report concerning the effects of alkaline preparations as adminiſtered by Mrs. Stephens and others, that the urine flowing from the body has been found to contain a white powder, of which great quantities have ſometimes been collected. This powder has uſually been conſidered as part of a concretion, or as gravel that had been lodged in the paſſages until brought away by the alkali. It is, however, very different in properties from the lithiſiac acid, and agrees in every reſpect with the earth that may be precipitated from urine, by adding an alkali to it when diſcharged. The vulgar error, of ſuppoſing it the matter of gravel, is one of the many circumſtances which yield teſtimony of the ſuperficial reflection, or extreme ignorance, in regard to every thing that had relation to the diſeaſe; and as calculous matter, I believe, it has been conſidered by all who have treated of the operation of alkalis.

A ſimilar ſediment of earth may naturally take place under particular circumſtances of the body. In ſeveral caſes I have obſerved it on the day ſucceeding an exceſſive indulgence in intoxicating liquors, when the ſtomach has been diſordered to the occaſion of moſt diſtreſſing ſickneſs, and an immenſe ſecretion of the biliary fluid. In ſuch inſtances, it may be owing to the redundancy of bile becoming conſpicuous in the urine by its alkaline principle: and the effect furniſhes preſumption of the great influence of the liver in reſpect to the proportions of acid and alkali in the fluids. But it may be ſaid, that the yellow colour of the bile ſhould, at the ſame time, be conveyed to the urine, as when bile is abſorbed from the ducts of the liver, or from the gall-bladder. That colour, although it pervades every thing in the alimentary canal, does not naturally paſs from the inteſtines. It is not uſually perceived in the contents of the lacteals: perhaps it may be loſt in the moment of abſorption, and during the paſſage of fluids through the membranes of the inteſtine into the abſorbent veſſel. Tinges from other matters, to the new modification of which the powers may not be adequate, are frequently tranſmitted; but the chyle does not appear to receive any colour from the fluid of the liver. It ſeems not improbable that, in the inteſtine, a portion of the alkali of the bile is transferred from the reſin, which deſcends under an excrementitious form, to ſome oily or mucilaginous product of digeſtion, with which it is connected in that milk-like compoſition called chyle. From the chyle it may be taken up by a native acid in ſome other part, where, by a new modification of its concomitant matter, there is a further progreſs towards the perfection of blood, or the compoſition of animal fibre.

Some of theſe milky fluids, and milk itſelf in particular, while they contain latent acids, which fermentation can diſplay, or ingenuity extract, are, in their natural ſtate, rather of an alkaline quality, and appear to comprehend fixed alkali in conjunction merely with ſomething gummy or reſinous, or with the matter of oil or mucilage. Milk ſeems to ſaturate a ſmall portion of acid, and its coagulation by acids may be in part owing to the abſtraction of alkali,

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by which the mucilaginous matter was ſuſpended. *Quære*, May not rennet, which, although not of itſelf an acid, yields a whey not unſimilar to that obtained by acids when the exact portion of acid which is accurately neceſſary for perfect coagulation is employed, be a ſpecies of matter which furniſhes a baſis, that by union with ſomething in the interval before coagulation takes place, for its effect is not immediate, becomes an acid in the proportion that is wanted?—or in milk may not be the baſis, to which the rennet may convey an acidifying principle? The extraordinary coagulating powers of this matter have not been perfectly elucidated, and might make a ſubject of curious inveſtigation. In coagulation in general, it muſt be conceived, that the coagulant, or a part of it, unites with the coagulum, ſo as to render it incapable of continuing combined with the water that is thrown off; or that it joins with the aqueous portion, ſo as to cauſe a precipitation of the ſolid ſubſtance, according to the laws of ſingle or double decompoſition; or that by means of a proceſs, which may be conſidered as a kind of fermentation, it gives occaſion to the formation of new products, towards the compoſition of which its own elements, under different modification, may be applied,

plied; and by which one or other of the firſt mentioned alterations is effected. When, as in the caſe of rennet, the neceſſary quantity is ſo ſmall as to appear to operate by magic, and a period intervenes between the application and effect, the generation of ſome new body may readily be ſuſpected.

The circumſtance of milk, the natural food of the early part of life, a kind of food of itſelf ſufficient for the moſt perfect ſuſtenance of the body under every ſtage, appearing to incline to ſuperabundant alkali, might be brought forward as a ſtrong argument againſt acids: for, although it is aceſcent if left to ſpontaneous fermentation, it is unſuited to the digeſtive powers, when any acid is produced from it in the ſtomach. But the mention of chyle and milk has occaſioned a conjectural digreſſion from which it is time to return, or the reader's patience may be exhauſted before he gets to the end of the few remaining pages.

Not uncommonly on the day after a debauch, lithiſiac acid is redundant in the urine; but at other times, and eſpecially when the epigaſtric functions have been much diſturbed, ſo as to occaſion great excitement to the liver, an abſorbent earth is found in a ſeparate ſtate. This is a circumſtance for the mere aſcertainment or confutation of which every man may not be inclined to an experiment on himſelf, becauſe, although the neceſſary trial would be ſimple, and not liable to much error in the execution, the conſequences might be complex and inconvenient. Yet there are few men, even in the ſerious and ſolemn profeſſion of phyſic, to whom opportunities will not ſometimes occur of drawing concluſions *de propriis perſonis*. During ſea-ſickneſs there is frequently an augmented ſecretion of bile in high degree, and of long continuance. I have not had an opportunity of inſpecting the urine at that time, but ſhould not be ſurpriſed to find that earth was ſometimes in a ſtate of precipitation from alkali being redundant. I think I have ſeen a diſpoſition to the ſame appearance, or at leaſt a diminution, in the quantity of a cuſtomary lithiſiac ſediment from the operation upon the liver of a violent emetic.

A ſuperabundance of alkali may perhaps happen in particular habits, and cauſing a precipitation of earth might be ſuppoſed to become the ſource of concretion in different parts, and even of a diſeaſe correſponding in its nature with gout. It was admitted that there are inſtances of mixed concretions, which appear to be compounded of lithiſiac matter and an earth, while volatile alkali and carbonic acid ſuperabound in the urine. It does not appear, however, that actual concretion has ever been produced by the moſt liberal medicinal uſe of alkalis. Simple animal earth has little diſpoſition to get into a chryſtalline ſhape, but mixes rather with water into a mucilaginous conſiſtence. And entirely unfounded are the notions that have been entertained, of alkalis cauſing a diſſolved ſtate of the fluids. By a tendency to correct indigeſtion and the errors of acidity, they conduce to the proper operations of the alimentary canal and its appendages, upon the condition of which the functions of the whole ſyſtem have much dependance; while their diſpoſition to increaſe evacuation by the emunctories in general, is ſecurity againſt injury from an accumulation of earth. They may be enumerated among the moſt effectual guards againſt the retention of matter that ought to be diſcharged. In diſeaſes proceeding from redundancy of acid, they would be of intrinſic value on this account, independent of their counteracting the primitive ſource: and it ſtands on numerous records that, with few exceptions, the general health of perſons under a judicious courſe of alkalis has been improved. As was ſaid of acids, it is not to be ſuppoſed that they are equally adapted to every conſtitution; but in thoſe particular habits, to whom on account of any affection from predominating acidity they are neceſſary, they will commonly be otherwiſe advantageous.

There are ſeveral peculiar morbid conditions under which prevalence of alkali has been ſuſpected; but it may be remarked, that there has not often been any certain authority for the preſumption. A lithifiac ſediment, indicating ſuperabundant acid, is common in many complaints. The ſyſtem, under irritation and diſorder, appears to incline to acidity, and, as was formerly mentioned, acid is frequently ſuperabundant at the end of fevers, during the progreſs of which neutrality had continued exact. But I believe a ſediment of earth, the certain conſequence of predominating alkali, will not generally be met with under ſome affections that have been conſidered as alkaleſcent. In ſcurvy, the urine, as deſcribed by *Van Swieten*, carries evident marks of redundant acid. *Urina autem ſcorbuticorum rubra eſt, cum ſedimento gravi copioſo, lateri rubro contrito, aut bolo rubro ſimili, quod ſedimentum, ſi urina igni imponitur, denuo ſolvitur.* Here is a neat and accurate deſcription of a true lithiſiac ſediment. In this diſeaſe, the native acid of fruits, and aceſcent vegetables, appear to be extremely adapted to the digeſtive faculties, nauſeated by a long continuance of vitiated diet and corrupted air; but ſimple acids are not found of much advantage: the others are of uſe, not on account of acidity, but as being ſuited to the exiſting powers of aſſimulation, by which the acid and mucilage of vegetable productions are converted into proper fluids. From the nature of the urine, and the cuſtomary diminution of ſecretion by the emunctories on the ſurface of the body—a diminution which is noticed in almoſt every account—it ſeems probable that alkalis, which would ſoon effect an alteration in the urine, and whoſe powers in clearing the ſkin are ſcarcely inferior to thoſe of any other medicine, might be employed with better ſucceſs than mere acid. But it is dangerous to ſpeculate upon diſeaſes which a man knows only by report. Perhaps, in malignant ſtages of the diſorder, volatile alkali may predominate. Thoſe, to whom it belongs to have ſcurvy under frequent obſervation, may attend to the urine, with a fair proſpect, if acid appears generally redundant, of deriving benefit from alkalis with ſuch conjunctions as individual circumſtances may point out: they need not be intimidated from the trial by the vulgar but ſuperficial notions of their ſeptic tendency. It is certain that they are frequently blended advantageouſly with other medicines in caſes commonly termed ſcorbutic, of which many may be regarded as ſlighter affections of the ſame nature with true ſcurvy.

I would not maintain that ſtones are often capable of ſolution in the bladder. I have not had practical opportunities of making many obſervations upon the ſolvent powers of alkalis; as inſtances of concretion, which have become too large to be diſcharged with the urine, are chiefly confined to the lower claſs of people, who get into hoſpitals, where they immediately paſs through the common operation. But the effect of alkalis is ſo far from being improbable, that to reaſon it appears almoſt unavoidable; and if they are not commonly attended with ſucceſs, the principal difficulty will be in accounting for their failure. It is capable of the cleareſt demonſtration, that the urine may be rendered a fluid which would be an active menſtruum for a ſtone: what then ſhould prevent ſolution?

A retired or unexpoſed poſition may be an obſtacle to that proceſs. A calculus may frequently be precluded, by its ſituation in the body, from being acted upon by ſolvents. A ſtone pent up in the kidney, and embraced almoſt

moſt in the extent of its ſurface by the ſubſtance of that gland, or included in a bag formed by the protruſion of the inner coat of the bladder, would be in a great meaſure defended from any menſtruum.

The chryſtalline hardneſs of many calculi is unfavourable to their being diſſolved. A body of very firm aggregation of particles and compact texture, is not readily acted upon by its proper ſolvent. Calculi that are porous, and permit the penetration of water, muſt be ſuppoſed more eaſy of ſolution, than ſuch as preſent an impenetrable ſurface.

When the petrifying proceſs is at an end, it is to be feared that the concretion may become enveloped in mucus adhering to its ſurface, ſo as abſolutely to protect it from the action of the urine. This is, perhaps, a frequent occaſion of the inefficacy of ſolvents, and may be the ſource of that relief from irritation, which is generally obtained in a little time after the uſe of the ſolvent has been commenced. The ſurface of the ſtone, no longer preſenting that aſperity which attended upon every freſh coat of recent chryſtals, becomes ſmooth by the intervention of mucus, and ceaſes to cauſe much uneaſineſs, but unfortunately is at the ſame time ſaved from the operation of medicine. Even the cilaginous matter that is precipitated from the alkali by the lithiſiac acid, may become attached to the ſtone, after the ſame manner in which a precipitate is uſually depoſited upon any ſolid body which has been the cauſe of precipitation; and it may contribute towards an artificial coat. The acquirement of a mucilaginous cruſt muſt be adverſe to ſucceſs. A free uſe of diluting liquors, which of themſelves tend at leaſt to prevent the increaſe of a ſtone, and in which alone, as cuſtomary vehicles, have been reſident the ſole virtues of ſome reputed ſolvents, with as much exerciſe as the patient's ſituation will admit, may be of ſervice in obviating this impediment.

Obſtacles like theſe that have been mentioned may render abortive every attempt at ſolution. But after contraſting the probable conſiderations that incline towards the efficacy of ſolvents with thoſe by which their operation may be foiled, it is neceſſary to remark that, notwithſtanding the length of time ſince alkalis came into favour, there have not been many practical applications from which poſitive concluſions could be derived. It appears from well-authenticated caſes, that calculi have ſometimes been removed by the uſe of them: in others, where they have failed, it is probable they may frequently have been exhibited in an improper manner, and without due regard to the means of promoting their effects, or of avoiding circumſtances by which their powers would be counteracted. It is to be lamented that medicines of this kind have been much neglected by regular practitioners, becauſe miſtaken ideas of calculi led to diſtruſt of the powers of ſolvents. The employment of them has reſted chiefly with empirics, who were ſo ignorant of every principle upon which they ought to be adminiſtered, that ſour rheniſh and other acids have ſometimes been joined with the alkaline *lixivia.* It is not ſurpriſing that valuable remedies, when ſhamefully abuſed, ſhould have ſunk into diſcredit. The ſubject is of great importance, and claims more particular attention than has been paid to it, from thoſe who have the care of hoſpitals, and meet with frequent inſtances of calculi.

When alkalis or earths are employed for the correction merely of redundant acid, large doſes are not commonly required, and the mild or cauſtic forms are equally ſuited to the purpoſe. But when an attempt is made to diſſolve a concretion in the urinary paſſages, the uſe of them ſhould be puſhed to a greater length, and the form beſt adapted to the ſolution of a ſtone ſhould be preferred. The cauſtic alkali, diſſolved in ſimple water, might be too harſh for the ſtomach, but when mixed with a ſolution of any animal matter, it becomes ſufficiently ſheathed, yet retains the power of acting upon the calculus. There is not occaſion for its being fully ſaturated as in ſoap, which is an offenſive nauſeating compound, containing a proportion of alkali very inconſiderable in compariſon with that of oleaginous ſubſtance againſt which the ſtomach revolts. Soap would not lend aſſiſtance to the digeſtive faculties, of which the improvement ſhould be kept in conſtant recollection. A ſolution of any animal jelly, or perhaps milk by itſelf, or with the addition of a little iſinglaſs, would generally be ſufficient for covering the alkali. When cauſtic alkalis are largely diluted with water, a ſmall portion of mucilaginous matter is ſufficient for diveſting them of any precarious acrimony; and vegetable mucilage, ſuch as that of gum arabic, linſeed, or marſh-mallows, might be adequate to that intent.

The mild alkali has not a greater effect upon urinary concretions than water by itſelf; yet alkali ſuperſaturated with carbonic acid has lately become a faſhionable remedy, under the the title of *aqua mephitica alkalina*. The pains and expence employed for the improvement of medicines, have frequently tended to render them of leſs utility. Fixed air, when it was firſt diſcovered, the knowledge of vapours being at that time in its infancy, became a ſubject of much attention, and was elevated to the importance of an univerſal panacea. When the novelty, however, had worn off, it ſuffered much abatement in eſtimation, to the poſſeſſion of which oxygene or vital air may, perhaps, be exalted for a time, and the virtues which were aſcribed to it had almoſt ceaſed to be in reſpect, till it came to be recommended as a ſpecific in gravel and calculi. This article, which deſtroys the ſolvent properties of alkalis, and renders them inert, is directed to be united with them to ſaturation as a remedy for ſtone.

But it may be anſwered, that, although the practice may appear inappoſite in theory, experience is in its favour, and that a long liſt of caſes, in which *aqua mephitica* has been employed with ſucceſs, can be produced. The liſt has been collected by an authority whoſe name lends credit to the catalogue, and who, feeling not any intereſt but that of benevolence in the recommendation of this medicine, will not be offended with rational ſtrictures on its operation. He is entitled to general gratitude for recovering public attention to a ſpecies of medicines, concerning the properest forms of which others muſt be allowed to expreſs thoſe opinions, to which their different ſentiments reſpecting concreting matter and concretion give riſe. An alkali, under this ſtate, may undoubtedly be of ſervice. By correcting acidity in the canal, and any redundant phoſphoric acid in the circulation, it will put a ſtop to the petrifying quality of the fluids, ſo as to be a remedy for gravel, and leave a concretion to the tardy action of the urine alone. In caſes of gravel merely, when there is not any accumulation of chryſtals, but only a depoſition from day to day, let *aqua mephitica*, or any condition of alkalis that is moſt agreeable, be employed: but when ſo great an object as the ſolution of a ſtone is deſired, the alkali ſhould be uſed in conjunction with ſomething from which it will ſeparate to unite with lithiſiac acid. The largeſt doſes ſhould be employed, and the exhibition continued with the moſt precautious ſteadineſs, till there has been a fair trial of its effects. Cauſtic alkalis are not commonly more diſagreeable to the taſte, or more ungrateful to the ſtomach, than common alkalis. The larger quantities that can be employed of aerated alkali plead not much to its advantage; as the ſolvent quality of natural urine is not increaſed by it; at any rate the common kali or natron, conſiderably diluted, are ſufficiently mild for general purpoſes.

There may be ſome advantage in recommending *aqua mephitica*, becauſe patients are uſually inclined to employ, with more exact perſeverance, medicines under diſguiſe, and not compounded without art and difficulty, than the ſame articles in a ſimple but not leſs effectual form. A certain degree of myſtery is neceſſary to gain that confidence which is the principal inducement to patience and regularity under phyſical regimen. The alkali combined to ſaturation with fixed air may be a very beneficial remedy in preventing the depoſition of ſabulous matter; but unleſs the powers of actual ſolution are denied to alkalis, it ought not to be ſubſtituted for the cauſtic *lixivia* in caſes of calculi already formed. The laſt are entitled to a previous trial, and on failure, the other may be adapted for continuing that relief which is derived from a ſuſpenſion of the petrifying proceſs.

Fixed air, in the univerſality of its application, has at different times been recommended, in conjunction with water merely, as a ſolvent. The introduction of it is as antient as Stephen Hales's frivolous experiments with effervescent mixtures, and might, perhaps, be carried back to a prior date. Concerning it there is only occaſion to obſerve, that the compoſition is to be regarded as water with ſo ſlight an impregnation of acidity, as ſcarcely to partake of the vices or virtues of an acid. Much of the air will be detached into an elaſtic ſtate by the heat of the ſtomach, and remain in the condition of vapour in the inteſtine, ſo that the water will carry but little of it into the circulation, and in water of perfect purity there is much virtue. If it were poſſible that a larger quantity of it could be conveyed from the ſtomach to the bladder, it would become an occaſion of lithiſiac acid being depoſited; and indeed we have ſeen reaſon for preſuming, that the calculous depoſition ſometimes occurs from ſuperabundance of carbonic acid proceeding from error in the animal operations. That the ſyſtem, under particular circumſtances, is capable of forming large quantities of elaſtic vapour, which is probably in part carbonic acid, appears evident from a curious and inſtructive caſe of *emphyſema* communicated by Dr. Baillie, in the important tranſactions of a medical ſociety, of which he is one of the moſt diſtinguiſhed members. To indulge in ſpruce-beer, or any liquid containing a very large impregnation of that acid, might be imprudence in a calculous patient, although the dilution, by the profuſion of accompanying water, may be often ſufficient to counterbalance any evil that could be apprehended.

It may be objected to the uſe of alkalis, that calculi of a different deſcription from that, which, on account of the greater frequency of its occurrence, I have termed the ſpecific ſort, might not be adapted to their operation. Dr. Dawſon's prudent injunctions, in reſpect to an examination of the urine and its contents, are never to be omitted. The urine will be the criterion of the nature of a calculus; and it is the faithful index, by attention to which, the action of alkalis ſhould be regulated and meaſured: it is a guide which ſhould always be accurately conſulted. I may, however, obſerve that, even in thoſe calculi which contain a large portion of earth capable of ſolution in muriatic acid, lithiſiac matter, from its tendency to a chryſtalline form, is probably the bond of connection. If by means of alkalis the lithiſiac portion be taken away, the depoſite will be a ſimple ſediment of earth with particles unconjoined. If it ſhould be aſcertained that in all ſuch calculi there is a greater or leſs proportion of lithiſiac acid, as their reported textures and colours would evince, the abſtraction of that, which, although it may be ſmall in quantity, is the article that inclines chiefly to concretion, muſt be the main object.

If a man were to ſpeculate upon the probable cauſe of theſe mixed concretions, he might with plauſibility aſſign an improper fermentation running beyond the point of acidity, and continuing in the circulation, where the requiſite aſſimulation into living particles may ſometimes be as defective as the aſſimulation of digeſtion in the ſtomach, till it approached towards the point at which volatile alkali is produced. Fermentation like this might be conſidered as having ſome reſemblance to a putrefactive proceſs. I would not ſuppoſe putrefaction in fluids that had aſſumed vitality, while they poſſeſſed the principle of life; but it may eaſily be conceived to happen in others, which from functions, by which that principle ſhould be conveyed, being incomplete, have remained not merely in the ſtate of dead matter, but of matter in the progreſs of ſpontaneous fermentation that had commenced in the ſtomach, and was continued in the blood veſſels—or it could not be thought improbable in thoſe fluids, which, in the natural waſte and renewal of ſubſtance, had deſcended from the condition of living particles to that of excrementitious matter. The common change may not, in its kind, be diſſimilar to an incipient putrefaction, which in ſome caſes may make preternatural advances, till carbonic acid and volatile alkali are extricated.

If this hypotheſis—for as hypotheſis only, diſtinct from the general ſyſtem which iſſues not from imagination's ſtore it is ſet down, were eſtabliſhed, alkalis would not, under the firſt ſuppoſition, be unſuited to the caſe. By combining with the matter while in a ſtate of acidity, the preliminary ſtage, they might cauſe a ſuſpenſion of the fermentative proceſs, and ſave from a ſediment either of lithiſiac acid or earth. Under the circumſtance of the ſecond conjecture, they would remove the lithiſiac matter of the ſediment, as has juſt been ſtated. In the ſingle inſtance of anomalous urine, which I had an opportunity of inſpecting, the mucous matter was not unlike to the mucilage of putrefaction, and the ſmell had ſome reſemblance to the hepatic odour of predominating acidity, conjoined with putrefactive fœtor. A fermentative tendency of this kind, from conſtitutional defect, or peculiarity of habit, muſt not be confounded with the acute and accidental alteration that is ſometimes ſuppoſed to proceed from violent fever, or from the corrupt excitement of baneful contagion. The error may occaſionally be not in the general temperament, but in the particular action of the kidnies cauſing a morbid modification of the urine.

The operation of alkalis ſhould be connected with every collateral circumſtance that may tend to the general health, or particular object. They may often require the regulation and aſſiſtance of other medicines. In a ſolvent, which for a period of years has maintained conſiderable repute, and of which the oſtentatious character appears in the columns of almoſt every newſpaper, opium ſeems to be joined to a fixed alkali in its cauſtic ſtate. Some preparation of poppy may frequently be a neceſſary and uſeful ingredient. It is much to be wiſhed, however, that the ultimate effect of alkalis may be aſcertained by experiment that ſhall ſtand on better ſupport than that of intereſted quackery. Too juſtly it may be ſaid of them at preſent, that they have ſeldom been employed with due regard to all the circumſtances that are neceſſary for a fair and exemplary trial. Regulations for the cure of diſeaſe are frequently but half performed, and reflection is thrown upon the means, when perverſion or miſapplication are the cauſes of failure.

I have endeavoured to contraſt with impartiality the arguments that perſuade to confidence in alkalis, with thoſe that militate againſt them. The advantage appears in favour of the firſt, or their pretenſions are at leaſt ſo ſubſtantial as to claim re-conſideration from perſons whoſe prepoſſeſſions may not have been in their favour. But if effects ſhould not keep pace with the flattering inference of opinion, it muſt be gratifying to calculous patients to be informed of the ſignal ſucceſs, which, under ſkilful management of the improved operation of the preſent day, has attended Mr. Earle in an extenſive line of practice; and they will have infinite ſource of ſatisfaction in the knowledge of means which can ſecure againſt the re-production of a ſtone, and ſave from the diſtreſſing apprehenſions of their miſeries being renewed.

The mild alkali is not incapable of acting upon many biliary calculi; therefore it may be employed in liver caſes with good effect. The large doſes that may be given are here a recommendation. To paſſage, however, by the duct that leads into the inteſtine, a painful but not very dangerous proceſs of nature, we are chiefly to truſt for relief from exiſting concretions in the liver and gall-bladder, and ſhould direct our principal view to the prevention of freſh ones. The concretions of gout are obviouſly beyond the reach of ſolvents. Depoſitions, that by frequent increaſe have become conſiderable, will often continue permanent; and, by cauſing impediment to natural functions, are obſtacles to complete recovery from the diſeaſe.

Earths that form neutral compounds with acids, may be uſed with excellent effect in correcting acidity in the firſt paſſages; and ſo much does ſuperabundant acid in the fluids depend upon the alimentary canal, that during the frequent and plentiful uſe of ſuch articles, urine which had been commonly diſtinguiſhed by lithiſiac ſediment, ſhall be diſcharged in its natural condition, not diſplaying any morbid depoſite. For gravel they may become remedies, when introduction from the ſtomach and inteſtines has been the cauſe of predominating acidity. Magneſia, on account of its opening quality, and want of acrimony even when calcined, would be an eſtimable abſorbent, but for a diſpoſition to flatulency frequently ſucceeding to its operation; it corrects acidity, a principal error of a weak digeſtion, but does not often contribute to the amendment of the digeſtive functions. By judicious conjunctions, however, the objection to it may be removed, while the full benefit of its beſt qualities is made certain. There is not any thing, which it is of more conſequence in every caſe to find out, than a mild aperient ſuited to the individual circumſtances of peculiar habits; eſpecially as aloes, whoſe operation is grateful and ſalutary to the ſtomach, muſt generally be interdicted on account of a tendency to hœmorrhoidal affection, a cuſtomary concomitant upon that condition of œconomy concerning which we are treating. The immenſe quantity of carbonic acid diſcharged from common magneſia, when it encounters acidity in the firſt paſſages, is often the cauſe of very diſagreeable diſtention, which could not be brought forward in recommendation of fixed air, by the enthuſiaſtic advocates of that vapour.

Calcareous earth, in either a mild or cauſtic ſtate, is not liable to the inconvenience which ſometimes attends upon magneſia: it is always innocent, not having any diſpoſition to derange the actions of the body, and may be employed, even during paroxyſms of gout, by itſelf, or in conjunction with gentle ſtimulants to ſtomachic function, as in the aromatic confection; or together with medicines that diſpoſe to relaxation on the ſurface, and occaſional opiates. As lime-water requires to be drank in large quantities to be of any advantage, the moſt convenient form of calcareous earth for general exhibition will be chalk or prepared oyſter-ſhells, calcined not to cauſticity, but till the proportion of carbonic acid is conſiderably reduced. Animal earth, as employed in the *decoctum cornu corvi*, is a valuable abſorbent, not liable to the exception of proving inconvenient in the bowels by the emiſſion of gas, yet free from cauſticity in the ſtate of ſtrongeſt calcination. It was already obſerved, however, that an acid, when ſaturated with it, does not appear to be entirely deprived of its acidity.

Lime-water enters the veſſels by abſorption, and carries its effects over the ſyſtem. By ſuch additions as are made to the compound lime-waters, it may be rendered not an ungrateful liquid, and might, in ſome caſes, be ſubſtituted for every other fluid. Tea made with lime-water might ſoon, perhaps, be thought more offenſive in colour than in taſte, and would not be ſo much ſubject to the exception of flatulency as the common form of that refreſhing and otherwiſe innocent luxury. In a work of juſt celebrity and eſteem, Dr. Blane's valuable Treatiſe upon the Diſeaſes of Seamen, lime is recommended for preventing the contamination of water, and lime-water employed for culinary purpoſes, is regarded not merely as devoid of prejudice towards the ſyſtem, but conducive to the prevention of dangerous bowel affections: it ſtands acquitted of pernicious effects, upon an authority of nice obſervation and accurate diſcernment. With ſuperior advantage it may be admitted where the morbid inclination of the habit is to redundant acidity.

Volatile alkali, which excites the operation of the ſtomach, and is an agreeable ſtimulant to the ſyſtem, may be made very beneficial in caſes of languor and inaction. It rouſes to requiſite exertion the exterior arrangement of an indolent habit. This, and alkaline medicines of every kind, may be occaſionally combined with purgatives, with bitters, with reſins, with aromatics, with chalybeates, or with any remedy that may appear adapted to general conſtitution, or partial affection. There are not any caſes in which their mingled efficacy is more ſingularly eminent, than where, with prevailing acidity in the firſt paſſages, there has been accumulation or defective ſecretion of bile, with a ſurface that indicates diſorder in the capillaries, and perſpiration not rightly performed. The yellow eye, the cadaverous countenance, the general debility, the morbid aſpect, and the obviouſly inert condition of the ſkin, are ſucceeded, when long derangement has not occaſioned irrecoverable diſorder, by freſhneſs of colour, by the appearance of health, and by increaſed faculties of exertion. Salt of ſteel decompoſed by an alkali, with a predominating proportion of the latter, and aided by the active reſin of myrrh, is a remedy at preſent in juſt repute, on account of its peculiar efficacy in caſes where ſtomach and biliary affection is ſeldom abſent, and where prevailing acidity is, in common, at leaſt a concomitant ſymptom.

But here let me proteſt againſt the cuſtomary abuſe of the term *bilious*, in vulgar language: its miſapplication is ſo frequent, and would often conduct to ſuch injurious conſequences, that a medical ear is generally diſguſted with the ſound. All the diſeaſes that can occur are aſcribed to bile; and patients dwell with ſo much obſtinacy on the idea, that every remedy which ſuits not their own ſentiments of biliary affection is reſiſted, and danger makes rapid advances. An inflammation of the ſtomach is from bile—pleuriſy is from bile—fever and rheumatiſm are from bile!—Bile, in a word, is the origin of every evil.—It comes under reproach for the univerſal errors of the habit: and to make evacuation of bile is the object on which they are intent, when bleeding and bliſtering ought to be the remedies on which chief dependance is placed:—remedies, in few caſes more neceſſary than in acute inflammation of the liver. Inflammation may ariſe in that gland from all the common cauſes of inflammatory action, as well as from others peculiar to itſelf, and the abſence of violent pain may lead to fatal inattention or miſtake. In a caſe of ſimple inflammation, acids might relieve the concomitant phlogiſtic ſtate of the ſyſtem; yet one would rather be diſpoſed to place confidence in medicines which tend more immediately to increaſe natural ſecretion from the ſeat of diſeaſe.

Different kinds of mineral waters may be turned to good account in ſtomach affection; but as their qualities are various, and ought in general to be decided upon, more from minute practical obſervation, than from any light which imperfect analyſis has thrown upon them, they come not properly under diſcuſſion in an eſſay which is intended to comprehend only general principles.

It may be diſputed whether or not a cure of gout ought, in general, to be attempted. A means of cure which has ſometimes been purſued, not ſo much by obviating the cauſe, as by counteracting its operation upon the ſyſtem, is attended with infinite danger. By large doſes of bitters and aſtringents, the fits were prevented from taking place, but the functions of the ſyſtem became impaired; accumulation, the natural error of gouty habits, increaſed to the production of univerſal diſorder, or deſtructive plethora; and the œconomy was precluded from the general relief which a paroxyſm of gout would have enſured. It is not ſtrange, that in ſuch caſes fatal affections of the brain and of the viſcera ſhould have occurred, or that indolent rigidity, unſuſceptibility of impreſſion, and muſcular inaction, ſhould have produced a miſerable condition of helpleſs infirmity.

Very different is the plan on which we would proceed towards prevention and cure—oppoſite in its tendency is the ſyſtem now recommended. The primitive ſource is always held in view, and the means of avoiding it are ſuch as contribute to the improved exertion of every function. The great offices of digeſtion and ſecretion, to irregularities in which a multitude of diſeaſes may be aſſigned, are particularly regarded. Towards theſe ends, not only diet and regulation, but even medicinal aid is chiefly directed. Bitter and aſtringent remedies may be of occaſional ſervice, but are ill adapted to conſtant and indiſcriminate uſe. There ſhould be much caution in the employment of articles, which, if they are not of benefit, may be prejudicial. But where to exhibit in ſubſtance *cinchona*,

chona, *ariſtolochia*, or *uva urſi*, might be improper, an infuſion of gentian or columbo root, with fifteen grains of kali, or half a drachm of natron to each doſe, may be ſafe and ſalutary. Alkalis are innocent themſelves, and contribute much towards the efficacy and ſecurity of other medicines.

Bitters, like the greateſt number of vegetable ſubſtances, appear naturally to contain a portion of fixed alkali. In ſome vegetables the alkaline principle is ſuperſaturated with acids, and acidity prevails; but in bitters that principle is generally united with the matter of gum or mucilage merely. The quantity of alkali they yield is ſo conſiderable, that the kali uſed to be extracted from them in preference to vegetables in general, and was on that account denominated ſalt of wormwood. By their alkaline impregnation, as well as by their tending to promote the action of the ſtomach, they become beneficial in gouty and calculous caſes. An increaſe of alkali brings them nearer to the condition of bile, and gives greater ſafety to their operation, by connecting it with a habit of increaſed diſcharge from the emunctories.

From means by which general health muſt be promoted while gout was kept at a diſtance,

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there could not be danger: but if patients are not willing to endure moderate reſtraint, and continue to expoſe themſelves to the cauſes of derangement, by living as if their digeſtive faculties were not defective, and as if they might be irregular and intemperate with impunity, a proper and perfect fit of gout may ſometimes be deſirable, that it may prove a remedy for other morbid affection proceeding from a courſe of conduct to which their conſtitutions are inadequate. It happens unfortunately that reſtriction is ſevere penance to habits, which in general tenour are robuſt, and revolt at neceſſity which nature has not impoſed upon other frames of leſs conſcious ſtrength. It is to be lamented, that the faculties of aſſimulation are not always upon the ſame ſcale with the appetite.

But whether or not complete prevention be thought adviſable, it will be of great importance to be able to regulate the diſeaſe from an acquaintance with its main ſpring. It will be of no inconſiderable moment for a man, when he finds the diſpoſition advancing, to have an option in reſpect to the occurrence or evaſion of a paroxyſm, after reflecting upon his circumſtances at the moment, and the collated injuries or advantages he is likely to ſuſtain from it. It will be of conſequence to have the action under command, the ſymptoms under controul, the progreſs within the power of limitation, and to know how to make amends for the imperfections of a fit, when there has been accidental interruption to its right period, or conſtitutional impediment to its requiſite concluſion. For ſuch intentions, there are means ſo fully adapted, that diſappointment could not, in frequent inſtances, take place, when invincible obſtacles did not preſent themſelves, in enervation irrecoverable, particular diſorder not admitting of remedy, complication of ailments perhaps oppoſite in their kind, and in the treatment they demand, or in reſtleſs irritability of temper and vehemence of paſſion preying upon the body, and rendering abortive every meaſure that is attempted.

Gout, with ſuch eſſential attainments in the management, would be diſarmed of its moſt hideous terrors, and ceaſe to be an inflexible enemy to the convenience and comforts of life.

POSTSCRIPT.

WHEN the printing of the preceding ſheets had advanced almoſt to the laſt ſection, and the work was within a few days of being offered to public view, I was ſo fortunate as to meet with a Diſſertation on Calculi by Mr. Gaitſkell, in the fourth volume of Medical Facts and Obſervations collected by Dr. Simmons. His attention has been principally engaged by the inteſtinal ſtones which are found in the alimentary canal of horſes, but he likewiſe directs ſome conſideration to the urinary calculi of the human bladder, and adopts the ſentiments of Dr. Auſtin in reſpect to their production from mucus. I have already entered ſo fully into that opinion concerning the ſource of concretions, that it is unneceſſary to advance any thing more in confutation of it. Mr. Gaitſkell does not endeavour to ſuſtain it by new arguments, but ſtudies to enforce a few of Dr. Auſtin's moſt important poſitions, and expreſſes his own ſatisfaction in the concluſion. The only novelty in his remarks, is an attempt to account for the obvious difference between calculous matter and mucus, by ingenious reaſoning in reſpect to varieties of property in ſecretions, from difference in the condition of parts by which they are furniſhed. He ſuppoſes that, from particular affections of follicular membranes, the minute glands may ſecrete mucus with the property of concretion, and which may be diſtinguiſhed by the epithet, *lithic*.

The produce of any gland is undoubtedly as various as the peculiarities of action to which it is ſubject. Mucus, under different ſtates of action, is different in appearance, in conſiſtence, in colour, in odour, and in ſome chemical properties, ſuch as diffuſibility through water and readineſs of ſolution; but ſtill it is a matter to which the term mucilaginous may be applied, as a denomination comprehending all the common forms of animal ſubſtance, which, with ſuperficial diſtinction, are ſimilar in eſſential properties. They are ultimately acted upon nearly in the ſame manner, by water, by alkalis, by acids, by alcohol, and by fire. Healthy mucus is different from purulent ſecretion, but to examination they are equally mucilaginous. Entirely diſtinct is the effect with reſpect to lithiſiac acid. Reflection upon its properties, which to recapitulate would be impoſing upon the patience of readers, gives conviction of its betraying not a feature of mucilage or mucus. It is a matter of a ſingular kind, containing many elements of animal matter, but not reſolving into the common animal products alone. If it was proved to be entirely thrown out by mucous glands whoſe operations were diſordered, it muſt ſtill be conſidered as not leſs diſtinct from mucus than blood, when, in conſequence of diſeaſe, the general fluid of the circulation is unnaturally diſcharged by the excretories of ſecreting organs. In its nature it ſecedes much farther than blood itſelf from the condition of mucus, as of blood the baſis is mucilage. A portion of it may be occaſionally yielded by any gland; but the largeſt ſhare of it—a ſhare that may be preternaturally augmented by diſeaſe—has been demonſtrated in the urine as an elementary ingredient, coming along with that fluid from the kidnies, and capable of being ſeparated from it by precipitation.

If that portion of lithiſiac acid, which forms the lithiſiac ſediment that has been miſtaken for mucus, were furniſhed by the follicular glands of the urinary paſſages, it would not diſappear almoſt immediately, after a moderate uſe of mild alkali had been entered upon: the morbid action of glands could not be ſuppoſed to be altered in a few hours; and the aerated alkali conveyed by the kidnies to the urine is incapable of diſſolving the ſediment, ſo as to give it ſuſpenſion. It is evident that the alkali operates by abſtracting ſuperabundant acid, which, acting as a precipitant upon the urine, detaches from it a matter which entered into its original compoſition, and becomes the cauſe of the ſediment in queſtion.

Mr. Gaitſkell, having decided in favour of Dr. Auſtin's hypotheſis, takes notice of a different theory anonymouſly promulgated in " A Treatiſe upon Gravel and upon Gout, in which the ſources of each are inveſtigated." A work without a name receives honour from the manner in which it is introduced, and his reflections diſcover intelligence and candour.—But he muſt permit the author, with unfeigned obligation to him for bringing the ſyſtem with liberal comment into diſpute, to ſay ſomething in reply to the few objections he has urged. After ſtating, with juſt report, the opinion conveyed in that treatiſe reſpecting the nature of lithiſiac acid, its univerſality in the ſyſtem, the modes of its precipitation and concretion, with its influence in the production of calculous and arthritic affections, he contends againſt theſe poſitions, chiefly upon the grounds of gravel and gout being leſs frequent in warm climates where the uſe of acids is profuſe, than in the northern regions where that claſs of bodies is not ſo abundant.

Thoſe who have attended to what has been repreſented in the former, as well as in the preſent publication of this new ſyſtem in regard to prediſpoſition depending—upon the condition of the emunctories—upon accumulation from defect or inequality of ſecretion, as influenced by many circumſtances, but by climate in particular—upon undue diſtribution from ſimilar cauſes—and upon the ſtate of the liver,—will not require any anſwer to theſe objections, or to another that is founded upon the diſeaſes not being always preſent in the ſame habit. It is not more ſurpriſing that gout and gravel, although proceeding from the ſame primitive ſource, ſhould not always go together, than that calculous affection ſhould ſometimes be entirely confined to one kidney. In every œconomy there are myſterious means of reſiſtance to the cauſes of diſeaſe, and theſe means are in different degrees, not only in different habits,

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but in different correſponding organs of the ſame body. Concerning circumſtances that incline to the injuries or innocence of acids, ſo much has been ſaid in the foregoing ſections, that nothing in addition ſeems to be required in reply to the ſtrictures of Mr. Gaitſkell upon thoſe varieties. The fact which is related on Dr. Moſeley's authority, of a ſtone having actually diſappeared in the Weſt Indies, after lithotomy had been adviſed by Mr. Pott in this country, is extraordinary and important. It goes ſtrongly in confirmation of what has been ſtated concerning the great efficacy of perſpiration in carrying off ſuperabundant acid from the ſyſtem, and ſhould give encouragement to the trial of ſolvents, when the urine alone could prove a menſtruum as ſoon as its petrifying proceſs was at an end. The employment of acids in warm climates is optional, while the free ſecretion from the ſurface may conduce to the proper action of the ſtomach when regularity is obſerved. Diſeaſe does not often occur till perſpiration has been obſtructed: but as ſoon as accumulation commences, the viſceral functions are deranged.

But I come now to more material concluſions againſt the unacknowledged theory of 1787.—Unacknowledged, and unprotected by any paternal care, for nearly ſeven years, it has been a wanderer left to the intereſt its own pleadings might excite; and to the ſame means of ſupport it muſt continue to look forward for countenance and reſpect. It is the legitimate offspring of one who regards it not without becoming concern, but has not any thing to beſtow that might gain it a favourable reception, or aid it in its progreſs, excepting facts and arguments—feeble pillars of dependance! For thoſe, however, and ſuch aſſiſtance as they can lend, it may draw upon him with ſure attention to reaſonable demands, and thoſe alone muſt conſtitute its defence againſt the difficulties and dangers of the pilgrimage to which it is compelled, and the buffettings it may encounter: but while its proſpects may be dreary, fortunate in ſome degree it ſhould be conſidered, in being claimed at laſt, as its honeſt genealogy is aſſerted, and future impoſition with reſpect to its lineage prevented. An imminent danger to which, unpatronized, it had been expoſed, was fraudulent extraction of its ſpiritual eſſence to be inveſted in new, but perhaps unbecoming garb, as the animating principle of other fabrics for whoſe errors and deformities it muſt come under reproach. From hazard like that it had not entirely eſcaped: a portion of it has already been infuſed into one production carrying profeſſion of originality, with a bare acknowledgment of the primitive mechaniſm having been ſeen, *after the new ſtructure was nearly completed*, and into another without a ſingle tributary alluſion.

It would be a difficult taſk for the author of the firſt of thoſe *original* inveſtigations, to aſſign a plauſible inducement to his numerous dietetic experiments before he had an idea of the important alteration produced by acids upon the urine. Theſe experiments are ſolely calculated to ſhew the effects upon that fluid from acidity in the circulation; yet thoſe effects he admits himſelf to have learnt from an anonymous author—when his treatiſe wanted but a little of being compoſed!—The end of his labours, before that information had been obtained, or the nature of his compoſition while he was ignorant of the principle on which it turns, it is not within the faculties of common imagination to conceive. His endeavours have been elaborate, for the purpoſe of illuſtrating a prime fact with which he only became acquainted after theſe endeavours were nearly concluded!

In the ſame author's leading poſitions and moſt materials diviſions, there is wonderful agreement with the anonymous writer, whoſe title, however, he never condeſcends to tranſcribe.

A title might have given riſe to enquiry for the book, which would have brought along with it conviction of plunder. It would have laid open the fountain of principles, which, ſeparated from the ſecrets it divulged, were without ſubſtance or ſhape. To ſecure againſt acidity in the *primæ viæ*, by attention to the *ingeſta* and to the condition of the ſtomach—to guard againſt accumulation of acid by reſpect to the emunctories—and to promote an improved aſſimulation of the articles of diet, by correcting diſorder or debility in the digeſtive powers, are topics on which the original ſyſtem was profuſe, and which, under almoſt ſimilar claſſification, conſtitute the principal magnitude of its uſurping ſhadow: while correſponding explanations of different effects from age, from ſex, from climate, and from habits of indolence or exerciſe, are preſerved. The theory has, indeed, been mutilated and curtailed in being rudely detached from its relation to gout; and it has ſuffered painful aſſociation with error, with fiction, and with abſurdity. It had not enjoined cold-bathing as a practice of general ſafety and utility in dyſpeptic caſes, where attending diſeaſe of the *viſcera*, or diſpoſition to arthritic affection, ought in frequent inſtances to forbid it. It had not expatiated upon venereal purſuits as means of improving the aſſimulating powers; it had not aſſigned vain and viſionary ſources of digeſtion being defecfective, nor inculcated the exhibition of the gaſtric liquor of brutes, as a principal remedy for debility in the functions of the ſtomach.

While that part of the ſyſtem which appertains to gout, has been excluded from *an enquiry into the remote cauſe of urinary gravel*, it has been cheriſhed by the author of the ſecond production, and aſſumed as original property, without the payment of any fine, or the admiſſion of any quit-rent, in *an enquiry into the nature, cauſe, and cure of the gout*—an enquiry conducted with great ingenuity and artful management, ſo as to render detection not inevitable to any but a perſon who recognizes his own ſentiments in every page, and meets frequently with a ſucceſſion of ſentences almoſt in his own language, or varied merely by ſome trivial difference in verbal arangement made for the purpoſe of diſguiſe. If that perſon were to be called upon for ſpecimens in ſupport of the impeachment he has made, he would mention the firſt and ſecond pages of the *enquirer's* preface, correſponding with the ſecond page of the orignal introduction—the obſervation concerning Sydenham's deſcription of gout, and the ſimilar excuſe for not entering minutely into the account of a paroxyſm—the remarks in regard to hereditary gout, and the hereditary influence of propenſities and example—the diſtinction between the ſimple remote cauſes, and thoſe whoſe operation is ſecondary, or tends only to give riſe to the diſeaſe, by a previous effect of producing in the digeſtive functions that debility and derangement which conſtitute its moſt common ſource—the operation of occaſional cauſes—he would follow the *enquirer* in his reaſoning reſpecting corpulent and robuſt habits, acidity in the *primæ viæ*, and free indulgence in acid liquors, the difference of effect from diſpoſitions to ſecretion or accumulation, and almoſt every other ſubject that is diſcuſſed in his numbered paragraphs. He could draw between the two works a parallel which ſhould produce conviction of ſuch coincidence in ſentiment and mode of expreſſion as could not be fortuitous, or the conſequence of accidental accordance of opinion, but the evident effect of imitation and tranſcript. He ſhould be willing to ſubmit the deciſion to any unprejudiced court of literature—courts before which every author and his claims muſt be arraigned—and would requeſt that judgment might be given from compariſon with his laſt treatiſe in preference to the preſent one, becauſe in this the arrangement is altered, the expreſſion often varied, and particular points leſs forcibly maintained, while many that are new have gained admittance. He could could even demonſtrate that he has been followed in parts of his former argument, which were doubtful, and not ſo tenable as the general baſis. It may be ſuppoſed that continued reflection on the ſame ſubjects ſince 1787 has brought to his notice ſome circumſtances which he might diſcover to be ambiguous, but which his copyiſts have elevated to importance.

In one reſpect, indeed, there is a difference between the anonymous author's inveſtigation, and the late enquiry. The ſame ſources of what is termed gouty acrimony are maintained, with ſimilar diſtribution, and ſimilar illuſtration of its effects, by correſponding references to rheumatiſm and other circumſtances. But the ENQUIRER has avoided the particular operation of predominating acidity in cauſing an evolution of lithiſiac acid. He is ſatisfied with *arthritic acrimony* as a term, without attempting any definition of its nature. Perhaps it was prudent to avoid bringing lithiſiac acid into diſtinct account, as particular mention of it might have made the analogy too ſtriking to be overlooked:

or the *enquirer* might not feel himſelf adept at argumentative ſupport of a chemical diſcuſſion, and yielded to the apprehenſions of inaccurate deduction: he is contented with conſidering the ſeveral remote cauſes as conducive to general acrimony, whoſe qualities he leaves as undetermined as the former vague ſuppoſitions in regard to gouty matter; and from incomplete conceptions in reſpect to the actual condition of gouty habits, he gives obſcurity to the whole doctrine, by blending it with abſtruſe notions in reſpect to nervous functions, and with ideas not eaſily comprehended, concerning irregular and atonic gout. The ſame want of correctneſs in conſidering the eſſence of the diſeaſe, has conducted to miſapplication of principles in various inſtances, and to the recommendation of practice ſometimes inappoſite and injurious. Of this kind may be regarded the employment of leeches, which, by diminiſhing the local affection, gives interruption to the natural proceſs that alone can tend to the general ſymptomatic excitement abſolutely neceſſary for the relief of the whole ſyſtem, and procures temporary eaſe at the expence of the univerſal œconomy. From errors like theſe, cuſtomary experience of their bad effects has long furniſhed ſecurity, which diſtinct reflection upon the proper depoſite of gout, and the general tenor of the conſtitution at the commencement of a paroxyſm, ſhould confirm. But while defects are pointed out, it muſt not be denied that other ideas have received a degree of expanſion and embelliſhment; or that the enquiry is, in general, carried on with no mean ability, and might have been read with ſatiſfaction by the anonymous author, if any reference had been made to the ſpring from which the principles have been borrowed almoſt in the order according to which they had been ranked.

The *enquirer* culls with dexterity, and is a proficient in the art of tranſplanting.—He knows in what manner to produce a ſeeming difference in flowers by variety of culture.—His ſoil is not barren, but ſometimes in fault from profuſion of manure. Frequently he ingrafts where the conjunction is not harmonious, and the conſequent ſhootings, although luxuriant in bloſſom, are not abundant in profitable fruit: all his readers will not go along with him in the extent of his digreſſive ſpeculations reſpecting ſchrophula, concerning acrimony as the univerſal cauſe of inflammation, in regard to the operation of artifical diſcharges made habitual, and

on

on other topics often irrelevant to the ſubject of the work.

While charges of plagiariſm, unintereſting to the multitude are brought forward, the more important buſineſs of this poſtſcript is at a ſtand.—To that I now revert, with hopes of excuſe for remonſtrances which cannot give offence to men concerned in the preſervation of literary right. I truſt I ſhall be juſtified in reſenting unfair pretenſions to originality, aſſumed to the prejudice of what has been ſo long on printed record, and from proper eſtimation of circumſtances I dread not the reproach of having laid unfounded imputations. It may be conceived to be matter of ſatisfaction to find, that ſentiments, which wanted even the authority of a name, have become ſo much the objects of enviable plunder as to have ſupplied matter for two entire publications; and that they have been inſtrumental towards begetting extraordinary diſcuſſion concerning ſubjects which had been almoſt relinquiſhed as fruitleſs of recompenſe to any labour that might be beſtowed upon them.

Mr. Gaitſkell admits the fact, of there being a conſtant precipitation from the urine upon the addition of acids; but the matter that is thrown down he has collected, and did not find it agree with the lithiſiac matter of Scheele, in particular characteriſtic properties. "It was inſoluble in water, inſipid to the taſte, and changed the blue infuſion of red cabbage leaf to a green colour. Inſtead of forming roſe-coloured chryſtals after ſolution and evaporation in nitrous acid, a yellowiſh white powder was left, which appeared to be animal earth." He enumerates other circumſtances in which it was different from lithiſiac acid, and thinks it had greater reſemblance to the coagulable lymph of the blood.

I will not again travel over the catalogue of its properties, and their nice agreement with thoſe of the common matter of urinary concretions, but requeſt to be conſidered as pledged to the ſtatement that has been given in the ſecond ſection. I would willingly abide by the determination of any man who has been in the habit of making chemical experiments with requiſite care. But I muſt take the liberty of pointing out ſome incongruity in Mr. Gaitſkell's remarks, and of offering ſome conjecture in reſpect to the cauſe of his miſtake. It is allowed that the precipitate is not acid to the taſte—neither is the matter of calculus. A ſubſtance, of which an ounce of water of the degree of heat that the tongue can endure without injury, does not, perhaps, retain half a grain, is ſcarcely to be diſtinguiſhed as an acid by the faculties of taſting: but it betrays its acidity by combination with alkalis, not into a ſaponaceous or viſcid compound, ſuch as is formed between alkalis and every deſcription of animal mucus or mucilage, but into a brittle ſubſtance, having greater reſemblance to neutral ſalts, and like them, much more readily ſoluble in hot than in cold water. In its ſimple properties and qualities of conjunction, it comes much nearer to ſulphur, the eſtabliſhed baſis of an acid, than to the matter of mucilage; but it is ſuſceptible of eaſy decompoſition, which ſulphur is not yet known to admit.

Mr. Gaitſkell obſerves, that the precipitate was not capable of ſolution in pure water. By what means then did it communicate a green colour to the infuſion of red cabbage? Here was evidence of ſolubility at leaſt, although the nature of the change may be conſtrued to the prejudice of its acidity. I am not acquainted with its effects on that infuſion, or with the minute qualities of the red cabbage as a teſt. To lacmus or tournſol, the ſaturated ſolution of the precipitate in boiling water appeared to give a faint red colour, in a ſufficient degree to be regarded as a criterion of acidity.

With reſpect to the roſe-coloured maſs that ſhould remain after evaporating the ſolution in nitrous acid to dryneſs, I have never failed in obtaining it when the experiment was conducted with tolerable care. The appearance, however, is not that of a clump of red chryſtals, which Mr. Gaitſkell ſeems to have expected. I have never found the reſidium in a chryſtalline ſhape, but more in the form of burnt allum when the moiſture is abſtracted. There is, as was mentioned in the third ſection, conſiderable nicety requiſite for gaining that ſtate of the yellow ſolution, which ſhall be colourleſs upon the ſkin when firſt applied, but become of a blood-red in about half an hour. The nitrous acid, moderately diluted, ſhould be boiled with an exceſs of the precipitate, till it has taken up as much as it can diſſolve. When the conjunction has been made to complete ſaturation, the limpid fluid ſhould be poured from the undiſſolved precipitate into a freſh vial, and the boiling continued ſometime longer, that if there be a particle of ſuperfluous acid it may be carried off. The experiment conducted in this manner, in a vial not very deep, and with a mouth wide enough to allow of ready evaporation, will commonly ſucceed. Scheele obſerves that the fluid, when it is boiling, becomes of a blood red.—I have never found this to happen, excepting when, by the violence of heat, the yellow ſolution had been raiſed upon the ſides of the containing veſſel, and dried into a roſe-coloured lining, which became a die for the liquid at the bottom. The addition of a fixed alkali, by taking off any redundant acid, renders the proceſs leſs liable to failure; and whether an alkali has been employed or not, the reſiduum, after evaporation to perfect dryneſs by means of a gradual heat, is a roſe-coloured maſs, which, however, when prepared without an alkali, has not appeared to me ſo deliqueſcent as Bergmann regarded it. I do not remember that Scheele, in whom there is much more preciſion of experiment and remark than in Bergmann, has made mention of deliqueſcency.

Inſtead of this peculiar red maſs, Mr. Gaitſkell obtained, after evaporation, a yellowiſh white powder, which appeared to be animal earth. There will not be occaſion for much argument to prove that the ſubſtance precipitated from urine by muriatic acid could not be animal earth, for which that acid is ſo ready a ſolvent. An error there muſt have been in the proceſs, and perhaps it had taken place in drying the precipitate by the aid of heat. The lithiſiac acid undergoes a degree of decompoſition in a very ſmall degree of heat, and yields a vapour ſtrongly impregnated with volatile alkali. As the decompoſition advances, an earth, which appears to be calcareous, and calcines ultimately to quick-lime, is formed. To quick-lime, the precipitate itſelf, and its roſe-coloured combination with nitrous acid, are converted in the end, after every thing volatile has been diſſipated by the continuance of heat. The ſuppoſition of its having been decompoſed by a degree of heat that was not ſuſpected to alter its nature, will perhaps account for the effect upon the colouring matter of red cabbage, and for other phenomena which have led to erroneous concluſion. The facility with which volatile alkali may be extricated from the lithiſiac acid and its compounds, is extraordinary, and teſtifies a great aptitude for a different modification of particles.

When the precipitate of urine is wanted for experiments, let natural urine, in which acid does not predominate, be decanted from the mucilaginous cloud before an acid is mixed with it, and the lithiſiac matter, when precipitation has been effected, will be perceived, not in the ſtate of a powder, which Mr. Gaitſkell appears to have conſidered as its cuſtomary form, but in the ſhape of fine chryſtals looking tranſparent in the fluid, but reſembling red ſand when detached and dried. By filling a large bottle every morning with freſh urine, a quantity ſufficient for experiments will ſoon be collected: it may be waſhed by agitation with diſtilled water, and afterwards, when operated upon with expertneſs, it will not cauſe diſappointment in the expected proof of its identity with calculous matter.

I am perfectly unacquainted with the nature of the inteſtinal calculi of horſes.—It ſeems probable that they are not formed like urinary calculi, by chryſtallization or depoſition from a fluid, but conſiſt of the earthy particles of the excrementious matter of the inteſtines, adhering to ſome ſolid body, retained and becoming an accidental nucleus. At the ſame time the bile, and various ſecretions of the canal, muſt contribute towards the compoſition. Mucilaginous matter may be in thoſe concretions the cement that it was ſuſpected to be in calculi of the human bladder. Mr. Gaitſkell's experiments teſtify their conſtitution to be of this kind. If there be lithiſiac acid in the fluids of horſes, a portion of it may enter into the compoſition of theſe calculi, and ſome of the appearances he has mentioned are favourable to ſuſpicion of its being preſent. If I were to ſearch for it, I would get rid of the earthy matter by means of muriatic acid before the application of nitrous acid was made, or examine with care the precipitate made by acids from an alkaline ſolution. In Mr. Gaitſkell's attempt to get, by means of nitrous acid, a yellow ſolution changeable to red, the effects were thoſe of that acid acting upon the ſkin as a cauſtic, and not ſo fully ſaturated as he had ſuppoſed, and as it undoubtedly might have been by a body containing an abſorbent earth. The ſame cauſe of deception is not unuſual in trials with lithiſiac acid: the proper liquor does not operate upon the ſkin, but is a mild varniſh which becomes red by expoſure to the air, on any ſurface by which it is not chemically affected.

Of the urine of horſes, I have examined but one parcel, and did not detect any lithiſiac acid: it contained a yellow ſediment which was principally an earth ſoluble in nitrous or muriatic acids, and capable of precipitation from both by alkalis. I might, perhaps, be inexpert in my endeavours to diſcover lithiſiac acid, or it may not appertain to the œconomy of that claſs of animals, or the want of it might be a morbid deviation from the natural ſtate of the urine. Theſe are points which it may be of importance for the profeſſor of the Veterinary College to aſcertain, but were not to me ſufficiently intereſting to induce to a proſecution of the enquiry, when other objects claimed more particular attention.

In the third volume of the ſame medical facts and obſervations—a work, with the many intereſting communications of which, I had till lately the misfortune to be unacquainted, although not a ſtranger to its general fame, an important ſeries of experiments upon urinary calculi by Mr. Lane, is given as an extract from the Philoſophical Tranſactions. In different concretions he found conſiderable diſparity in reſpect to their readineſs both of ſolution in alkalis and evaporation in the fire: thoſe which diſſolved in the largeſt proportion were moſt volatile in heat. The reſult of his experiments upon fourteen double parcels of calculous matter, is ingeniouſly arranged into a table ſhewing the *reſidua* of each, after correſponding parcels of the ſame concretion had endured the operation of cauſtic alkalis, and of a heated furnace. Of the fourteen, it appears that ſeven or eight were of that deſcription which may be conſidered as tolerably pure lithiſiac matter. A refractory reſidium of from one grain to three, of ten, the original quantity, is not, when of the higheſt rate, much more than may be expected from lithiſiac acid, as found in calculi or precipitated from the urine. The remains of the others were larger; and in ſome which did not yield much to alkalis or the fire, it may be preſumed that there was a different matter accidentally connected with the lithiſiac acid, or that a particular aggregation of particles reſiſted the operation of alkalis and of heat, under the common circumſtances.

We have commented upon the different appearances which lithiſiac matter puts on when precipitated from the urine, and upon the varieties of ſediment depending upon ſome heterogeneous conjunction. Such differences are certainly to be aſcribed to the coheſion of other matter which may be of various qualities and proportions; but the concreting principle is connected with the lithiſiac acid, and that there is unity in that principle, may be concluded from the diſparity of ſolution and evaporation which Mr. Lane diſcovered in different lamina of the ſame concretion. No. 11 and No. 12, the external and central parts of a calculus, left ſcarcely any *reſidua*, while No. 13, formed of intervening lamina, proved refractory. If there were actually different and oppoſite ſources of concretion, it is ſcarcely to be expected that they ſhould exiſt in the ſame perſon. The depoſition of every part muſt have been from the ſame cauſe, and the eſſential matter of concretion the ſame, with the difference of ſome other matter happening, at particular times, to be contained in the urine, and, by accidental attachment to the calculous acid, giving variety to its aggregation, its texture, its ſuſceptibility of ſolution, and its volatility.

The only conjectures that were offered reſpecting the cauſes of difference, were that fixed air may ſometimes be comprehended in the depoſite; it precipitates calculous matter from alkalis, but a portion of it may unite with the precipitate—and that the mucilaginous cloud is frequently included in various forms of lithiſiac ſediment. From a calculus containing a large proportion of the firſt, there would not be much reſiduum: from another, to which the ſecond had contributed, the remains might exceed the uſual quantity. When artificial precipitation is effected, if the urine be very diluted, and not ſtrongly impregnated with animal ſalts, the chryſtals, while immerſed in the fluid are clear, and appear like ſmall ſhining particles of calcined mercury ſticking to the vial, or entangled in the cloud, but not conjoined with it. When the proportion of precipitate, which varies from leſs than a grain to three or four, and perhaps more, that may ſometimes be obtained from half a pint of urine, is larger, the depoſite frequently becomes evident by immediate turbidneſs, and ſettles as a powder with particles of different magnitudes, towards the compoſition of which the cloud or mucus of the urine has furniſhed a conſiderable ſhare. A ſediment of this kind will not be ſo perfect in its properties as the pure chryſtals, yet the lithiſiac acid is equally eſſential towards its compoſition, and ſuperabundant acidity is the ſource.

It is probable that the concretions which were found to leave a very large reſidue, might conſiſt in part, like ſome which Dr. Dawſon examined, of an earth ſoluble in muriatic acid —an earth that might be calcareous, argillaceous, or magneſian. The nature of theſe concretions would have been more fully aſcertained, by trying the effects of acids, with an exception of the nitrous acid, whoſe operation is ſingular, and renders it an univerſal ſolvent of calculi, upon the reſidues of the alkaline ſolutions, and the effects of alkalis upon what remained after the force of acids was expended: or nitrous acid might have been employed upon the part that was left by muriatic acid. In this manner the ſpecific matter of calculi would have been ſeparated from its foreign attachments, and their reſpective proportions aſcertained. Boiling water is a good teſt of calculous matter by the depoſite it makes on cooling. If the ſolution be paſſed quickly through a filtering paper as ſoon as it has been removed from the fire, the lithiſiac acid begins in a little time to ſubſide in the ſhape of chryſtals, or of chryſtalline threads. Theſe are the acid in its integrant ſtate of a compound body with uniformity of properties. The experiments of Mr. Lane were happily deſigned, and the mode of relation does not leave any doubt of the execution having been correct.

It is to be lamented that pecularity of aggregration, or the caſual attachment of ſtrange matter, ſhould produce difficulty of ſolution, or defend the ſpecific lithiſiac portion from the action of alkalis. But ſolvents ought not to be rejected for theſe reaſons: if they ſhould prove occaſionally ſucceſsful they ſhould be conſidered as always entitled to a fair trial, before a precarious and painful operation is undertaken—for with the greateſt improvement of which it is capable, precarious and painful it muſt remain. But when alkalis may not be equal to the ſolution of calculi already formed, they might have been beneficial, combined with other regulations, in preventing the generation of bodies, of which the concretion may depend upon lithiſiac acid, even when its proportion is not the largeſt in the maſs. We muſt conſider that acid as the combining ingredient or baſis of concretion in all the ſtones where it is preſent; and it has not been proved that any have yet been diſcovered from which ſome portion of it may not be extracted: while in the greateſt number of calculi the adhering matter of a different kind is ſcarcely worth notice. The whole reſidue after the operation of heat, is not to be conſidered as adhering matter: the earthy remains proceed in general from the decompoſition of the calculous acid itſelf. The proper acid may be decompoſed —the ſublimate may be decompoſed—the ſublimated products of every freſh ſublimation may be decompoſed: at the end of each proceſs there is a reſidue of earth, which may be the reſult of new modification; or, if it pre-exiſted in the original body, was ſo enveloped in myſterious conjunction as not to be perceptible under the character of earth. The quantity of the firſt reſidue may have relation to the degree of decompoſition that has taken place from particular circumſtances attending the operation.

But it is time to bring to a concluſion an enquiry of which a great part muſt be unintelligible to perſons unacquainted with chemical phraſe. I have endeavoured to trace the origin of complicated diſorders, which, connection in their cauſes, brings under under one ſyſtem. The means of prevention and remedy recommended, are ſuch as diſpoſe to improvement in very neceſſary functions of the œconomy. When uſed under the limitations and reſtrictions that have been aſſigned, it may, at leaſt, be ſaid in their favour, that they cannot prove injurious when they are not efficacious. But when enforced with proper care and ſuitable regulation, there could not often be occaſion to lament, with the elegant author from whom our motto is aſſumed—*Eſt enim hæc ars conjecturalis, neque reſpondet ei plerumque, non ſolum conjectura, ſed etiam experientia: et interdum non febris, non cibus, non ſomnus ſubſequetur, ſicut aſſuevit.*

THE END.